Electrical Engineering

August 1939

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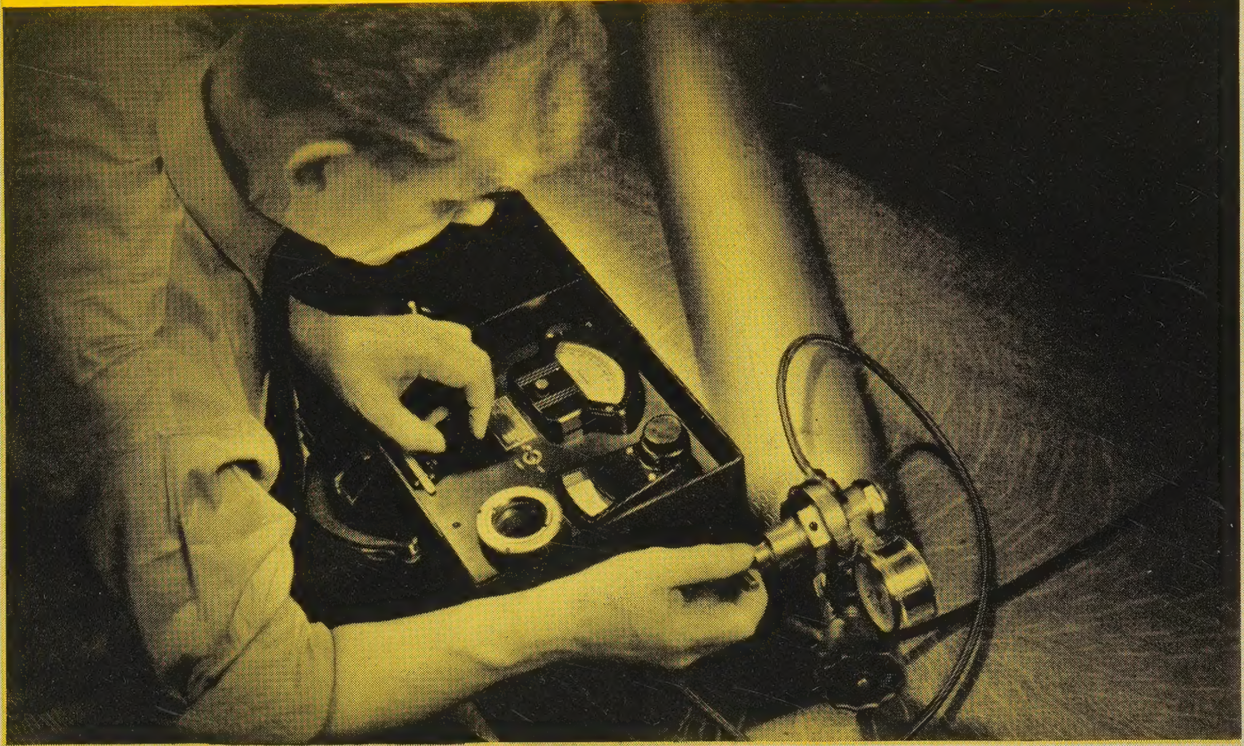
To Measure—MOISTURE CONTENT
ELECTRICALLY



MOISTURE is an elusive agent—all-pervading in nature and difficult to detect, difficult to eliminate or control. And when there's moisture in supposedly dry annealing gases, high-carbon steel decarburizes and becomes unsatisfactory for many uses. Razor blades made from it have poor edges; automobile and airplane gears do not hold up in service.

To help eliminate this handicap, G-E engineers were asked to devise an instrument which would improve annealing and heat-treating operations by determining the moisture content of gases. As "Headquarters for Electrical Measurement," the G-E laboratories had already solved other tough problems for industry—had made instruments to measure lightning surges and the trickle of electrons in a vacuum, instruments to measure color exactly and instruments to unscramble sound waves; and now they set to work on measuring moisture.

The result was a portable potentiometer which measures the dew point, or temperature at which moisture will condense from a sample of gas. (It's described in Publication GEA-2630, which is yours for the asking.) The moisture condenses on a thin, metallic mirror connected to a thermocouple and then to an indicating instrument. An operator regulates the flow of the cooling medium against the back of the mirror until the exact condensation point, or dew point, is reached and temperature readings can be made. Thus, another measurement problem was solved.

G-E engineers have brought to electrical measurement the experience of fifty years in almost every field of electrical endeavor. That's why there are accurate G-E instruments to measure almost any quantity—current, voltage, resistance, watts, frequency, power-factor—in dozens of standard styles, indicating and recording, and in ratings to fill every need. If you have a problem that involves measurement, remember General Electric, Schenectady, N. Y., as

HEADQUARTERS FOR ELECTRICAL MEASUREMENT

GENERAL ELECTRIC

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Electrical Engineering

Registered U. S. Patent Office

for August 1939—

The Cover: Permanently evacuated and air-cooled 100-kw 600-volt glass-tube rectifier unit. Photo Courtesy Allis-Chalmers

Transactions Section (*Follows EE page 364*)

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F. MALCOLM FARMER, President H. H. HENLINE, National Secretary

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¶ Statements and opinions given in articles and papers appearing in "Electrical Engineering" are the expressions of contributors, for which the Institute assumes no responsibility.

¶ Correspondence is invited on all controversial matters.

High Lights

Overvoltages. One session of the 1939 AIEE winter convention was devoted to the subject of the high transient voltages that may appear on power systems as the result of switching operations, lightning, and faults. In one paper the factors that determine the maximum voltages which may be obtained on a system following the occurrence of faults are reviewed and analyzed, and results of calculations and tests on a miniature system are presented (*Transactions pages 377–85*). Another miniature system was used for tests to determine recovery voltages with special reference to interruption of faults by protector tubes (*Transactions pages 405–13*). Several theories for the production of overvoltages are reviewed in a paper that reports studies of transients on a network calculator of a range of grounding conditions (*Transactions pages 386–97*). The effect of resistance on the closing and opening transients of inductive and capacitive a-c circuits is demonstrated graphically in a paper that also gives the mathematical basis for the curves (*Transactions pages 397–404*). Extremely high voltages theoretically may build up under certain circuit conditions from successive momentary clearing and re-establishment of current flow during switching operations, although tests show that the voltage actually realized is always less than the theoretical maximum (*Transactions pages 371–6*).

Summer Convention. A full report of the recent AIEE combined summer and Pacific Coast convention, supplementing the initial report in the July issue, includes, in addition to the main account of the convention (*pages 350–2*), a digest of discussion at the annual conference of officers, delegates, and members (*pages 352–4*), a summary of actions taken at the meeting of the Institute's board of directors (*page 355*), and a report of the board of directors' action on the proposed AIEE Model Law on the registration of engineers (*pages 354–5*).

Air Circuit Breakers. Use of a new form of deionizing arc interrupter for enclosed air circuit breakers for low voltages aids in reducing arc flame and gases, and together with other improvements leads to increased current-carrying capacity for a given size of breaker (*Transactions pages 414–20*). An air circuit breaker of the deionizing type for moderate-voltage switchgear has been tested with currents in excess of 37,000 amperes at 15 kv (*Transactions pages 421–6*).

American Engineering Council. Among items appearing in the current AEC *Bulletin* are: announcement of the new director of Federal public works; compilation of bills affecting patent procedure now under consideration by Congress; summary of some of the findings of the Federal Power Commission's study of utility companies in 1937 (*pages 357–8*).

High-Voltage Circuit Breakers. The standard circuit-breaker interrupting time of 8 cycles on a 60-cycle basis has been reduced to 5 cycles in the voltage classes from 138 to 230 kv by a new multiple-unit interrupter assembly that was evolved from a design used at lower voltages (*Transactions pages 427–34*).

Branch Prize Paper. A method of determining the efficiencies of fractional-horsepower motors from the heat produced by eddy currents is described in the current AIEE national Branch prize paper. The method obviates the principal disadvantages of brake methods and is simple enough to be easily applicable in industry (*pages 339–40*).

AIEE Lamme Medal. Eleventh recipient of the Lamme Medal, awarded annually to a member of the Institute for "meritorious achievement in the development of electrical apparatus or machinery," is Marion A. Savage (A'21). Presentation was made during the Institute's recent summer convention at San Francisco, Calif. (*pages 347–9*).

Responsibilities. If our conduct is to be more than a perfunctory performance of ritual, we must first know what we are after, says Retiring-President John C. Parker in discussing the responsibilities of the officers and individual members of the AIEE in his summer-convention address (*pages 330–2*).

Fibrous-Glass Insulation. Because of its advantages over organic materials, fibrous glass is finding increasing applications for insulation in electrical machines. Tests on unimpregnated samples demonstrate its superior qualities at high gas pressures and temperatures (*pages 341–5*).

More Use for the Decibel. The decibel scale and the geometrical progression on which it is based can be applied to the measurement of heat, light, electricity as well as to that of sound, says a communications engineer who foresees increasingly wide use for this unit (*pages 328–9*).

Modern Railway Signals. The track circuit, foundation of nearly all modern signaling, is analyzed and its development traced, in an article which also surveys background and present use of automatic train control and cab signals, centralized traffic control, and route interlocking (*pages 333–8*).

District Meetings. Plans are progressing for meetings to be held by the AIEE Great Lakes District at Minneapolis, Minn., September 27–29 (*pages 356–7*), and the Middle Eastern District at Scranton, Pa., October 11–13 (*page 356*).

District 4 Executive Committee. Delegates from the AIEE Southern District at a luncheon meeting during the recent summer convention discussed prospects for the 1941 summer convention (*pages 355–6*).

Traveling Waves. Separation of the components of traveling waves on power transmission lines may be accomplished by means of a special bridge circuit (*pages 345–6*).

District Paper Prizes. Prize awards for 1938 papers have been announced by three AIEE Districts (*pages 355–6*).

Coming Soon: Among special articles and technical papers now undergoing preparation for early publication are: an article on "Human Relationships," by A. S. Bennion, containing the essential substance of an address delivered at the general session of the recent AIEE combined summer and Pacific Coast convention; an article pointing out the dangers of the misconception that engineering methods can be applied as effectively to social as to technological problems, by R. W. King (M'35); an article reviewing the various methods of applying geophysics to the location of oil deposits, by Daniel Silverman (A'33); a paper on the rating of general-purpose induction motors by P. L. Alger (F'30) and T. C. Johnson (A'35); a paper on duty cycles and motor rating by L. E. Hildebrand (M'21); papers on the measurement of temperature in induction motors by E. R. Summers (A'38) and C. P. Potter (F'29); a paper discussing the temperature aging characteristics of class *A* insulation by J. J. Smith (A'19) and J. A. Scott (M'34); and a paper on temperature limits set by oil and cellulose insulation by C. F. Hill (M'29).

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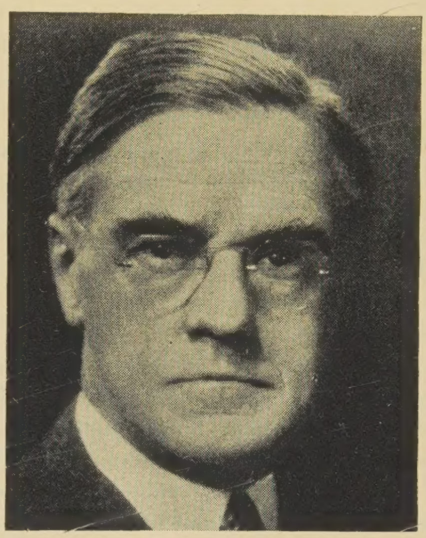
A Message From the President

To Members of the Institute:

IN RESPONSE to President Parker's most gracious introduction of the new President at the AIEE annual meeting in San Francisco after the announcement of the result of the election of new officers, I stated that I found myself at a loss for words which would adequately express my appreciation of the honor which has been bestowed upon me. The purpose of this "open letter," in addition to extending greetings to the membership, is to repeat that statement here for the benefit of those members of the Institute who were not present on that occasion, to thank all of you for your approval of the selection of the nominating committee, and to express the hope that your confidence will prove justified.



The principal duty which is officially assigned to the president is "general supervision of the affairs of the Institute under the direction of the board of directors." That is now very largely a nominal duty. With the conscientious boards of directors and the able national secretary which the Institute is fortunate in having, its affairs require very little supervision by the president. I expect to devote my attention principally to those matters which will help to maintain the best traditions of the Institute and which will assist in increasing its prestige as the professional body in the electrical branch of the engineering field.

It is quite probable that my conduct of the affairs of the Institute will not always meet with the full approval of all of our nearly 17,000 members. You will recall the time-honored story of the Scotchman living on the outskirts of the town who, upon the announcement of the street-railway company that fares would be reduced from five cents each to six rides for 25 cents, complained of the change on the ground that he had to walk to town six times instead of five to save a shilling. However, it should be remembered that it is not what the president does or says that is important. It is the actions of the board of directors that are important. The members of the board are selected by you and endeavor to carry out your wishes insofar as possible with due consideration to the best interests of the greatest number. But the board cannot know the desires of the membership unless they are made known. The members are therefore urged to keep in mind that this is a co-operative, voluntary organization in which each member has not only a right but a duty to submit directly to headquarters or through his District vice-president suggestions for increasing the value and influence of the Institute, and to express his opinion on the conduct of the affairs of the Institute whether such opinion is commendatory or otherwise.

Thanks to the able and efficient previous administrations, the material affairs of the Institute are in excellent shape. We are operating well within our income, our membership is steadily growing, and activities in the Sections and the Branches are steadily increasing. We have, however, at least two general problems confronting us which should be kept in mind as ones that will probably require more and more attention as time goes on. One is the meeting of the growing demands on the Institute's financial resources incident to the increasing membership and to the expanding scope of the electrical-engineering field. The other is the less material but perhaps more important one of maintaining electrical engineering on a professionally high plane. The stresses resulting from the social and economic changes of the past few years should not be allowed to develop strains beyond the elastic limit—beyond the point where we cease to conform to the tenets of a true profession. However, these and other problems that will confront us will be met with credit to the Institute and the profession if each of us will take as prideful and active an interest in its affairs as his opportunities will permit.

F. Malcolm Farmer

How Many Decibels?

H. P. LAWTHER
ASSOCIATE AIEE

Although the decibel and its relation to the theory of geometrical progression are familiar to communications engineers and engineering educators, many other engineers have not had occasion to analyze the implications of this comparatively new unit. To them, this article presents a definition in understandable terms.

IN 1925 the International Advisory Committee on Long Distance Telephony gave official recognition to the decibel as a unit for use in telephony. For a number of years previous in this and allied fields necessity had been mothering several varieties of a unit of the same fundamental character, and the action of the committee was a welcome and helpful step toward uniformity. The sciences of telephony, acoustics, and radio have experienced such rapid development and have attracted such widespread interest in recent years that by now their more common terminology has reached the sidewalk level. Many engineers, however, have not had occasion to work in these fields, and some may have wondered just what sort of thing the decibel is. Recourse to the dictionary has not been satisfactory, for there one found some such barren definition as "the logarithmic unit of power-increment," or "the usual unit for measuring the loudness of sound." Inquiry of some worker applying this unit in his daily tasks usually has proved equally futile. The difficulty has been that the concept upon which the decibel is based is as fundamental as human experience itself, and fundamental things in general cannot be described in tersely worded definitions.

For a moment let us turn back our imaginations to the early days of man's existence, when he was just beginning to learn to count and reckon. Imagine one shepherd of this age gathering his flock into the fold at nightfall and checking them in by driving them one at a time through a narrow gateway—transferring a pebble from one basket to another as each sheep passed through the opening. His experience at the moment would naturally suggest a pattern such as that shown on figure 1—where the group of sheep within the fold or the group of pebbles in one of the baskets would increase by successive increments of one. The succession of quantities thus suggested to him is, of course, the set of real integral numbers. This is the most fundamental of all arithmetical progressions and is characterized by the constant difference of unity between successive members.

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Figure 1

At the same time a neighboring shepherd might have completed checking in his flock for the evening and been looking toward the morrow in a contemplative frame of mind. He well might have been thinking of his ewe that had borne twin ewe lambs last spring, of the twin lambs which each of these in turn would bring forth next season, and so on, and thus of the tremendous herd he would have in a remarkably short space of time. This man's experience at the moment would naturally suggest a pattern such as that indicated in figure 2—a geometrical progression of integral numbers characterized by a constant ratio of two between successive members.

The patterns of figures 1 and 2 are equally fundamental to human experience, and the man who is led to the one

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Figure 2

is not necessarily more deeply thoughtful or more mathematically inclined than the man who is led to the other. The arithmetical progression was tremendously favored, however, by the invention of very convenient and workable symbols whereby counting and reckoning in this scale could be mastered by entire populations. The arithmetical progression, therefore, is the basis for the form of counting and reckoning which we today and our ancestors for centuries past learned so early in our lives that our very thinking machinery has been built up around it. For most of us formal introduction to the geometrical progression occurred when we reached the chapter on logarithms in our high-school algebras. We learned there that certain reckonings could be accomplished in this scale with extraordinary facility, but it was too late to do anything except learn to use the conversion tables for interpreting it in terms already familiar. Logarithms are only 300 years old, and while they have been of inestimable value, their use has been confined to a comparatively small group, comprising such specialists as astronomers, navigators, engineers, statisticians, and computers. For the great bulk of the population, logarithms and the employment of the geometrical scale have meant nothing at all.

While there has been no widespread acceptance of a system of counting or reckoning based upon a geometrical scale, it has been inevitable that a thing so fundamental must have thrust itself to the fore in many ways. The

Based upon a talk given at several AIEE Section meetings in the South West District in April 1939.

H. P. LAWTHER is transmission engineer, Southwestern Bell Telephone Company, St. Louis, Mo.

human sense of hearing is such that the musical octave has been necessary, and the octave is simply a unit step in a geometrical progression of frequencies based on a ratio of two. The succession of the cross-section areas for the Brown and Sharpe wire gauges follows with startling accuracy a geometrical progression with a base ratio of approximately 1.25. The obvious properties of an electrically long uniform transmission line forced the geometrical scale on telephone workers early in that science. The "standard mile," the "800 cycle mile," the "1000 cycle mile," and the "transmission unit" represented successively the birth, babyhood, childhood, and adolescent stage of the decibel itself. The several series of "preferred numbers" advocated by those interested in standardization are practical approximations to geometrical progressions that experience has taught to be desirable for governing the stock sizes of such things as nuts, bolts, screws, pins, or shafting. The use of logarithmic plotting paper and of the slide rule are more obvious examples.

From the point of view of this discussion, then, the decibel is to be defined as a number of value $10^{0.1}$ (approximately 1.26) used as the base ratio for a geometrical progression. The value of exactly $10^{0.1}$ has been chosen for two good reasons: First, it yields a unit of convenient size; and, second, it ties in directly with the tables of common logarithms which are universally available, and so facilitates conversions between this and the arithmetical scale. Both this number and the geometrical progression it governs are totally abstract magnitudes, equally applicable to the quantities encountered in sound, heat, light, electricity, animal husbandry, or any other field of experience where they may prove convenient and useful.

The geometrical scale differs fundamentally from the arithmetical in that it does not contain a natural zero reference point. It extends to infinitely large magnitudes in the upward direction, but it can never reach zero or attain a negative value. This peculiarity offers no drawback where the quantity under consideration is essentially positive in character and where experience suggests some logical and readily remembered reference value.

The communications engineer refers his "measured transmission loss" to his ideal of an electrically long, uniform, distortionless transmission line. A measured or computed result of 10 decibels, say, for a piece of apparatus or for a circuit would mean that the power received at the distant end of the transmission line would be reduced to $^1/_{10}$ of its value by the insertion of this item into the otherwise uniform line. In laying out his circuits the communications engineer designates one milliwatt as his reference for the power level (that is, peak value measured with a specified form of instrument) of the voice currents on the circuits. A level of +10 decibels or a level of −20 decibels would indicate 10 milliwatts or $^1/_{100}$ of a milliwatt, respectively. For measuring the noisiness of the extraneous currents that get onto any telephone circuit he elects a much smaller reference value, and designates 10^{-12} watts at 1,000 cycles for this purpose. A noise level of 30 decibels on a circuit would mean that the noise currents present as translated to the ear of an average telephone listener would produce a sound as loud as 1,000 times 10^{-12} watts of 1,000-cycle current would produce under the same circumstances.

When the same engineer is interested in the noisiness of a room in which a telephone instrument is located he employs the reference standard adopted by the acoustical people, namely, 10^{-16} watts per square centimeter for a 1,000-cycle free progressive wave in air. A room-noise level of 50 decibels at a given point would mean that an average human ear placed there would hear a sound of loudness equal to that of a 1,000-cycle free progressive wave in air of intensity equal to 10^5 times 10^{-16} watts per square centimeter. While applications have not as yet been made in such fields as temperature and illumination measurement, the decibel scale suggests itself as quite appropriate for these, and the writer has no doubt that the near future will find increasing use for it.

The fact that today large numbers of the population are employing the decibel unit in their daily activities and thinking—meaning that for the first time in man's history a geometrical scale of reckoning is getting down to the grass roots—offers an intriguing suggestion. The one mental computing wizard that this writer has had the opportunity to observe employed a pencil and paper and performed a perfunctory operation resembling addition when asked to multiply two large numbers together. Except for his extraordinary ability in this one particular, this individual appeared to be of very ordinary intellectual capacity. The presumption persists with the writer, therefore, that this man was exceptional only in that by accident he escaped the stupefying effects of conventional childhood educational routine, and was able to invent for himself a computing scale based on a geometrical progression—for in this scale multiplication is accomplished by operations similar to the simple ones that result in addition with the arithmetical scale. The suggestion that with future generations wizardry in computation may be the rule rather than the exception is left for the reader's fancy.

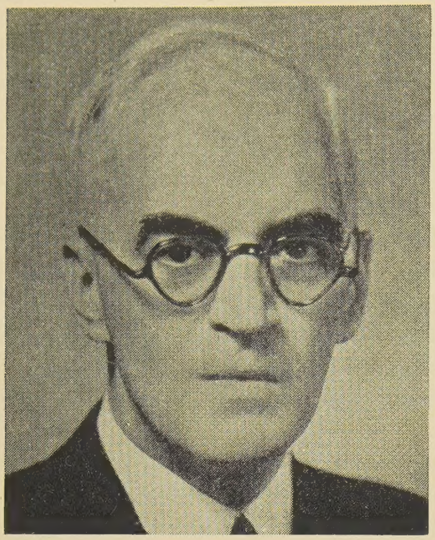
Decibels

Watch the meter as it tells
Decibels!
Profound confusion while it spells
Decibels!
Frequency and decibels are one.
A DB would not in decency
Be seen without a frequency.
As hearing is subjective
And a DB is objective
Loudness is a science just begun.

We are muddled up with DBs
Until we get the DTs.
From their sly implications
Often spoofy,
They give indications
Often goofy.
But the engineer will win
And the DB will give in,
And noise will be defined throughout the world,
By the straining and the gaining
of the bells,
Decibels!

T. M. Blakeslee (A'29) Los Angeles Section, AIEE)

Responsibilities in the AIEE



JOHN C. PARKER
PRESIDENT AIEE, 1938-39

For the Institute and its membership, Retiring-President Parker recommends "individual responsibility, individual work, and an organization developed along representative lines"

PART of the ritual of the AIEE annual meeting seems by tradition to be an address by the president of the Institute. Please note that it is an *address* that is called for and not a *paper*, the presumption being, I suppose, that the president of the Institute should not or could not present a technical paper. In the present instance this presumption is sound on both counts.

I do not know why commencement orations and presidential addresses are given. It may be that there is an illuminating parallel provided by that most sagacious of ancient animals, the African elephant. I understand that in crossing a crocodile-infested stream the old bulls go first and so muddy the waters that the younger members of the herd have protection through the creation of the screen churned up from the river bottom.

Then again it may be that an outgoing officer is tossed an opportunity through this device to make himself believe what all his auditors know to be sheer fantasy, namely, that he still has a spark of life left in him. In any case, if valedictories must be pronounced, I would much sooner make them than listen to them.

During the administrative year now closing I have had occasion—or opportunity if you will—to make quite a series of addresses at District, Section, and Branch meetings. This verbal outpouring has seriously mitigated the otherwise very great happiness that has come from visiting around with our own people in their home territory, renewing acquaintance with old friends, making new contacts, and experiencing the gracious hospitality and spontaneous camaraderie which are so characteristic of the Institute membership. It has seemed to me that if these visits were in any way to justify the effort of the members in turning out for such meetings, serious effort should be made through them to accomplish something useful for the Institute and for the society of which it is a part. To that end I have sought informally to evoke from the members suggestions and criticisms out of which the administration of the Institute could be improved. The results of these informal conferences have been brought back either to the administrative officers or to the board, as the case seemed to indicate, and have resulted in action which it is hoped in the long course will somewhat improve the processes of the Institute.

Objective improvement alone has not been a principal purpose in this process. It goes rather deeper than that. The Institute, like all human organizations, in a very just sense belongs to the members. Authority must flow from the periphery to the center, however easy a reverse process may be, and however much in the way of mere efficiency may be said for the latter.

A principal function of the president and of the regional vice-presidents of the Institute is, as effectively as we may, to determine the desires, the thoughts, the wishes of the membership; to bring these into the board meetings and there, in conference and by adjustment, to give them tangible expression.

This, of course, is not a democratic process, and indeed it seriously may be questioned whether, in an organization even of the size of the Institute, spread as it is over the whole extent of this country and representing as it does a highly diversified group of interests, any process of pure democracy can operate. I make bold to suggest that however much the processes of the referendum and the initiative may seem to represent an ideal, they would in effect represent not only an abdication of authority but, even worse, a desertion of responsibility by your officers and committee members. What then must we ask as an ideal form of organization of our professional interests? Would we contemplate an authoritarian national secretary with a society organized about him or a series of presidential officers each for a little time seized of the right to run our organization? Such a central organization would be most efficient without in the slightest degree being effective. It is a habit of administrators to withdraw into the isolation of their ivory towers, in the very process losing all perspective of the ends to which their efficient processes should be directed and perhaps too losing all sight of actualities through preoccupation with or infatuation by the processes of administration.

Full text of the president's address delivered at the AIEE annual meeting held during the combined summer and Pacific Coast convention, San Francisco, Calif., June 26, 1939.

Representative Administration

There is a third scheme of organization which it seems to me is the only effective one, and which we should seek further and further to stimulate in the Institute; that is the process of representative administration through which officers, with particular emphasis on the regional representatives, are carefully selected at once for their ability to exercise good judgment and because of a belief that they initially understand and continuously will keep themselves fresh in a knowledge of the will of their constituencies. Such representatives wisely will consult the membership and will guess correctly as to those things concerning which the membership may wish to be consulted. Consultation will concern general principles and will attempt to make an appraisal of results, but will not seek to burden the membership with the determination of specific details for which the members have selected their representatives.

It is obvious that the specific desires of one section of the membership may easily run counter to the specific desires of other sections, while there may be a complete unity of judgment as to the general objective underlying the more specific elements. This naturally calls for adjustment and compromise on nonessentials in order fully and intelligently to arrive at the main purposes.

Membership Responsibilities

Representative government calls for the highest type of representatives and puts on them a heavy burden both of conscience and of intelligence. Equally it places on the membership a responsibility that does not exist either under an authoritarian or under a theoretically democratic form of organization. To begin with, the selection of representatives by the membership must be responsible and thoughtful, and the members must be willing to bind themselves to every faithful execution by their representatives. Under such a scheme of organization the membership must be willing to view the operations of their representatives, not in detail but as to the general direction of representative determinations, or if in detail, only as details reveal the true character of fundamental consciousness on the part of the representative as to what are his responsibilities. No such responsibility on the constituency exists in a pure democracy since in the latter the individual records his voice directly and as he is moved at the moment, with no necessity for imaginative and sympathetic interpretation.

The process of representative government imposes a further burden on the membership. I have said that it is a principal duty of our presidents and vice-presidents as representatives informally to determine the wishes and the needs of the membership. This is a process that works two ways. If we are to have a representative organization, the members, both individually and through the local subdivisions of the Institute, must seek to make known their desires, their opinions, their criticisms, or their approbation. Beyond that they will best insure a government of the Institute that most truly expresses the will of the membership if they will seek to render service even in the most humdrum and pedestrian matters of the local groups.

No human organization truly can belong to its membership if any large section of its membership believe and act on the belief that it should be a benevolent thing apart from themselves, from which they may draw benefits much beyond the measure of what they contribute of themselves, not merely in an emotional loyalty, but in actual service.

I have taken this occasion to talk at some length about a theory of organization for our Institute, not alone because I believe it to be the one way in which the Institute effectively can be run, but because every principle here involved has, I am convinced, a vastly wider application which I think is sufficiently obvious without further elaboration except for this point. Because we here and in the larger fields of human enterprise do have to deal with frail and actual human beings, preoccupied with a wide range of distracting other activities, because the process of developing an ideal governance must be voluntary, we cannot expect that at any one time any human organization will have realized its best ideals; we must expect that progress toward that realization will be slow, halting, or even at times retrogressive. In times of doubt and discouragement men are prone to ask for a facile formula that will accomplish painlessly all the things that in fact can be brought about only by united, consistent, and plodding effort toward a clearly visioned ideal.

One recalls that the children of Israel in their long wanderings called on Moses to give them a king to reign over them that they might be as the other nations round about them, forgetting that the Lord Jehovah was their king. I suspect that we of the engineering profession are not immune to this natural human tendency to seek an easy, formalized, and institutionalized way of accomplishing those things which can come about only through the collective devotion of individuals expressing the genuineness of their aspirations through a willingness each and every one to do the thing that lies nearest to hand in the full spirit of an ultimate purpose.

We Must Know What We Are After

As in our daily jobs, so also in the profession and in the larger field of human relations, we would do well occasionally to draw aside from the busyness of specific performance and to ask ourselves one fundamental question. May I again refer to the great Law Giver of Israel? You may recall that in the institution of the Passover he suggested that when their children should ask them "What mean ye by this sacrifice," there should be an answer. If our daily jobs, if our purposes for this American Institute of Electrical Engineers, if our conduct as citizens are to be more than a perfunctory performance of ritual, a mechanical service of institutions, we must know what we are after. It is not enough that a more abundant supply of cheap electricity, a more perfect art of communication, a national system of broadcast of television, more efficient

motors, or more dependable circuit breakers should be built by us; it is not enough that stockholders should receive a more nearly adequate return because of our employment; it is not enough that our Institute be larger or financially sounder or that its publications represent a higher level of scientific and literary contribution; it is not enough that our nation shall be secure against enemies at home and abroad or that prosperity shall return to the land. These things are good; they are the things that we must bring about; but we must know in our several jobs, in our professional organization, in our operations as citizens, what we individually have in mind as the ultimate reason for the sacrifices that we are prepared to make and to ask of others. I say we must know what we as individuals have in mind. As an individual, no man can hope to know the absolute ideal toward which his efforts actually are being directed. He can only know what he thinks should be the ideal, and in this his thought will change as he grows in experience and in wisdom. Since, then, the ultimate objective of effort is individual and changing for each individual, it can never be expected to become a formulated expression.

Is this all fine-spun, unpractical philosophizing unworthy of consideration by the members of a most realistic profession? I think not.

There is a quality in men as they work at their jobs; there is a quality in professions as such; there is a quality in the citizenship of each nation that inevitably is expressive of inner light which unconsciously, unobtrusively gives direction to specific acts of performance and which in the aggregate accomplishes the greatest influence in human affairs. It may defy definition, but it is patent to all. Greek civilization, mediaevalism, the American spirit, each has a significance, not because of the things that were done, but because of an unexpressed inner urge. The mentioning of the name of an individual corporate enterprise calls up in your minds and in mine pictures of something, not expressed in the sales literature or in the product, which *is* that enterprise. Name one of the professions or one of the nonprofessional callings and immediately there springs into mind an intangible thing which is the inner essence of that vocation.

Let's leave it at that.

I recommend to the membership of the Institute individual responsibility, individual work, and an organization developed along representative lines, but above all else that, in the odd moments between wakefulness and breakfast, we occasionally give some thought to why we are engineers and why engineering should be a part of the processes of human life.

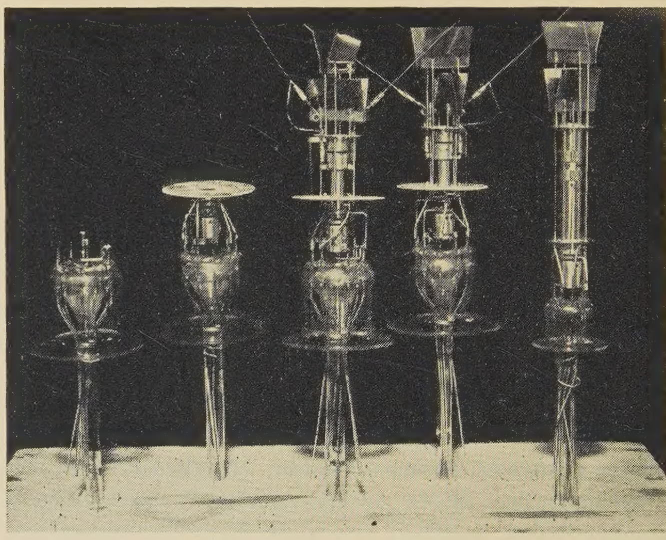
Nickel in Television

THE use of nickel and certain nickel alloys for the production of cathode-ray tubes is proving an important factor in the practical development of television. The cathode-ray tube, which translates electrical impulses into visual patterns, is an essential element of modern television sets. Within the tube, electrons emanating from heated metal are formed into a beam and projected on a fluorescent screen at the wide end of the tube. The screen is illuminated at the point of impact, and the beam, swinging across it at tremendous speed, creates the television image.

Great skill is required for the production of cathode-ray tubes, which are made up of an intricate assembly of glass and metal parts, subjected to severe tests before being used. To meet the requirements of cathode-ray-tube manufacture, a metal must have certain mechanical, electrical, and chemical characteristics. It must:

1. Be amenable to a wide variety of fabricating operations.
2. Be sufficiently strong, even in the softest temper, to avoid deformation during normal handling and use.
3. Remain strong at high temperatures.
4. Have a high modulus of elasticity, particularly at high temperatures.
5. Permit strong spot welds.
6. Be rust proof and corrosion-resistant.
7. Resist warpage and distortion regardless of high temperatures.
8. Have certain required electrical properties, especially proper electron-emission characteristics.
9. Be low in contained gas and readily degasified at moderate temperatures.

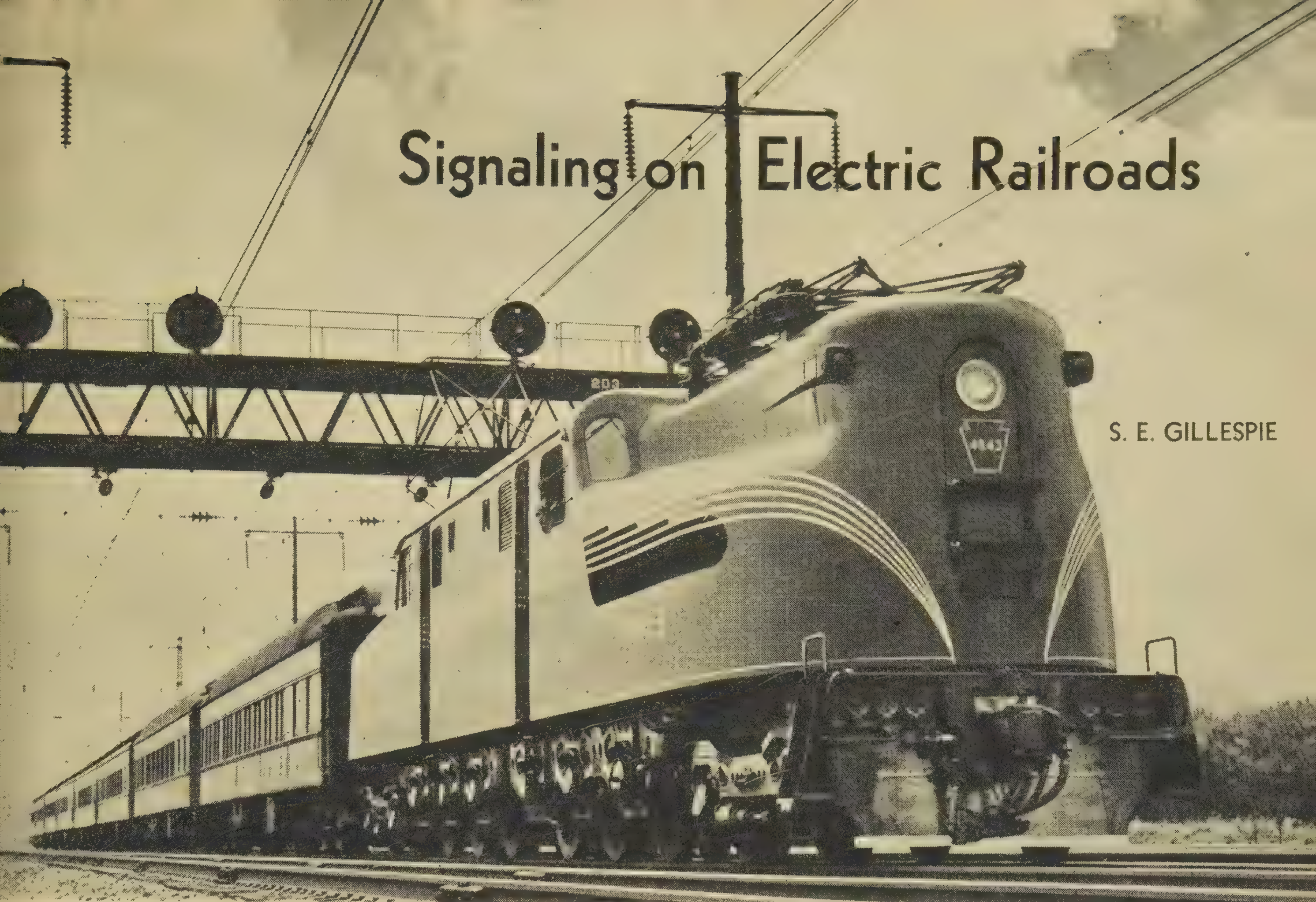
Experience in the production of radio tubes, X-ray tubes, and cathode-ray tubes for other purposes demonstrated the ability of nickel to meet the requirements of



television. The metal parts of cathode-ray tubes for television are made of pure nickel, supplemented by nonmagnetic alloys with high nickel content, such as "K" Monel and Inconel. The illustration shows a group of assemblies as inserted within the tubes.

Signaling on Electric Railroads

S. E. GILLESPIE



A survey of recent developments in signaling practice, with some consideration of their foundations and growth

WHILE this article is concerned primarily with recent developments in railway signaling, brief reviews of certain phases of the subject have seemed desirable, since this branch of engineering has developed a terminology in some respects peculiar to itself. Railway signaling may be divided into two nearly equal parts: circuit schemes to accomplish certain effects, and the apparatus with which the effects are produced. The designs of both parts are interdependent and proceed together, always with the objectives of safety and reliability. The recent developments to be considered are coded track circuits, automatic train control and cab signals, centralized traffic control, and route interlocking.

Track Circuits

The track circuit is the foundation of nearly all modern signaling, upon which the superstructure is built. It consists essentially of a metallic circuit, in which the running rails are the principal conductors, having a current supply at one end and a relay at the other. For purposes of track circuiting, the track is cut into sections as desired by inserting insulations at the joints; these sections may be a few feet in length or they may be a mile long, or even longer, as required. The rails are bonded together on each side of the track to insure continuity of the circuit. When the relay is supplied with enough current, its contacts close, but when a train is on the track circuit, it short-circuits the rails and shunts out the relay current to approximate zero; the relay contacts then open by gravity and interrupt any circuits passing through them.

The track circuit has proved so reliable a detector of the presence of a train that it has superseded every other rival device. It has the further advantage of indicating rail breaks when they occur.

Track circuits were first applied on tracks used by steam trains and were energized from batteries. When electric propulsion of cars and trains was introduced, and the rails were made to carry the return propulsion current, means had to be devised to provide a continuous propulsion return circuit and to render track relays immune to the return propulsion current.

The solutions found were these: to take care of the propulsion return current, one rail may be left uninsulated while the other is insulated into sections. Track circuits installed in this way are called single-rail track

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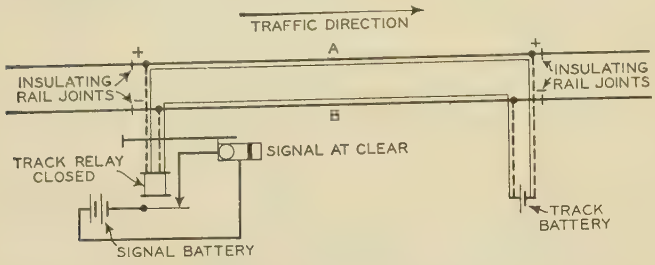
S. E. Gillespie is with the Union Switch and Signal Company, Swissvale, Pa.

Unoccupied: The track circuit current that holds the track relay closed flows from the track battery through the rails A and B to the track relay



Occupied: As train enters block section, the wheels shunt track circuit current from the track relay. Signal circuit is open and signal moved to "Stop"

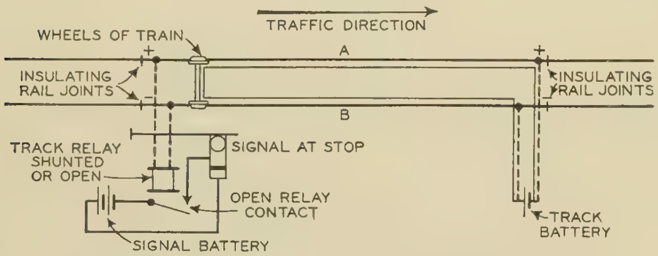


Diagram of d-c track circuit

circuits. They are feasible only where the sections are relatively short and the return current can be carried by one rail, or where a supplementary return circuit is provided.

Where single-rail track circuits are not feasible, impedance bonds are used to connect the rails of each track circuit to those of the next. Impedance bonds are essentially large choke coils connected across the track at each end of the track circuit, with center taps connecting to center taps on similar coils in adjacent track circuits. Of course the winding must have sufficient conductivity to carry the return current. For railroads with d-c propulsion, track relays were devised which operate on alternating current but not on direct current; the most popular relay for this condition is the two-element vane relay. For railroads having a-c propulsion, track circuits are energized with alternating current of a frequency different from that of the propulsion current, and frequency-selective relays responsive to the signaling frequency but not to the propulsion frequency are employed. The most successful relay for this purpose is the centrifugal frequency relay working on the weighted-arm governor principle. Even if 25-cycle current strays into this relay the motor will not spin the weights fast enough to close the contacts.

Among the railroads entering New York City, the New York Central, the Delaware, Lackawanna, and Western, the subways, and the elevated have d-c propulsion and track circuits operating on alternating current; the New York, New Haven, and Hartford, with a-c 25-cycle propulsion, has track circuits operating on 60 cycles and centrifugal frequency relays. The Pennsylvania Railroad has both kinds of propulsion current and both kinds of track circuits, and in addition coded track circuits.

Coded Track Circuits

When automatic cab signals and train control arrived, requiring receiving apparatus on the locomotive to be actuated by electric impulses inductively picked up from the rails while the locomotive is in motion, and requiring the locomotive apparatus to be responsive to as many as four different conditions, a new problem had to be solved. It was met by what is known as the code system, in which alternating current of 100-cycle frequency is fed to the rails through interrupters, or code transmitters, which interrupt or modulate the track current at as many different rates as required to convey the different messages. At first this coded train-control current was superimposed only when needed upon the regular track current, but the latest installations have largely dispensed with the former track-circuit apparatus and use coded current continuously. This code system may be used for controlling either wayside or cab signals or both, on railroads with any kind of motive power; consequently it is known as the universal coded track-circuit system.

This new system has a number of advantages over any previous development. It can be used to transmit three or four or more indications if required, over the rails only, without any line control wires at all. Since it employs a special frequency, different from any commercial frequency likely to be found in the vicinity, it is peculiarly free from the danger of interference. The receiver is tuned to the signal frequency and will not respond to any other; the energy, even though of proper frequency, must still be coded to produce any "Proceed" indication. Another factor of safety is that the track relay must continuously open and close its contacts to produce any "Proceed" indication, so that any interference with this uniform motion, such as electrical interference or mechanical failure or stoppage, will result in the most restrictive signal indication. Still another safety factor is that it is easier to insure a reliable shunt of the rails by a train with a track relay which is being continuously de-energized and re-energized, than with one which must be de-energized only. With the coded track circuit, it is relatively simple to put in cut sections when this is necessary on account of the length of the block, or to provide for the control of highway-crossing protective devices.

Finally, the elimination of line wires from the signal-control system removes a possible cause of signal interruptions during severe sleet and wind storms.

A coded track circuit has the following elements: a source of 100-cycle energy; an interrupter or code trans-

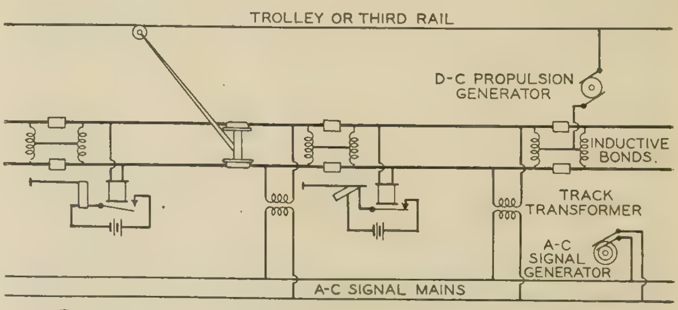


Diagram of a-c track circuit with impedance bonds

mitter capable of interrupting the 100-cycle track current at rates of 75, 120, or 180 times per minute; connections for feeding this intermittent energy to the rails; at the receiving end, a filter resonant to 100 cycles and blocking the propulsion current, and a rectifier; a d-c relay which will follow with its armature the code impulses received through the rectifier unit; a decoding transformer; a home relay which becomes energized whenever the code-following relay is working; one or more relays, as required, tuned to operate selectively on impulses occurring at rates of 120 or 180 per minute, for transmitting higher speed indications.

This arrangement is analogous to a broadcasting station transmitting on a frequency of 100 cycles per second, the carrier wave modulated or interrupted at rates of 75, 120, or 180 times per minute, and a receiver tuned to 100 cycles. The incoming carrier is rectified or detected. Three tuned audio circuits, or any required number, would respond selectively to their peculiar notes. The output is of frequencies much lower but corresponding to relative audio frequencies.

At the sending end of the circuit the frequency of modulation is automatically selected according to the conditions ahead affecting the safety of trains, and at the receiving end the signals are caused to display corresponding indications.

If a train intervenes it will short-circuit the rails, shunt out the track-circuit current, cause the signal governing that section to present its most restrictive indication, and cause signals in the approach to display appropriate cautionary indications.

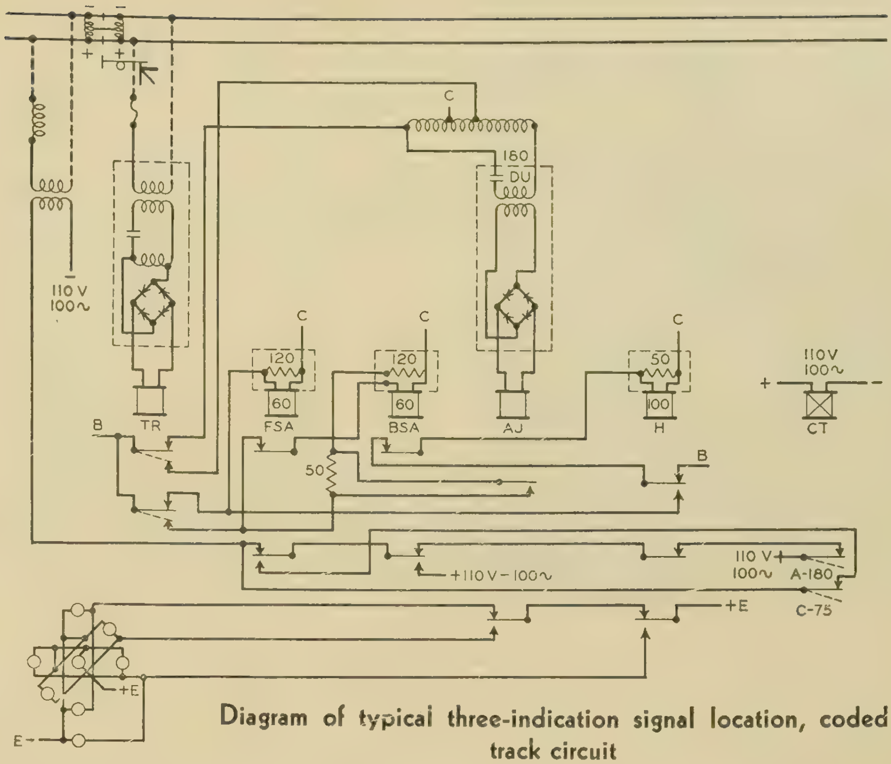


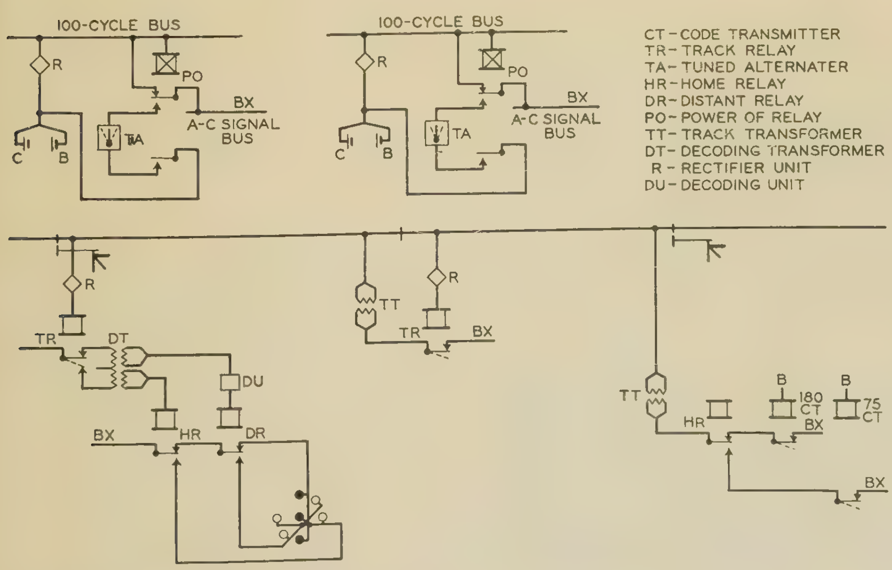
Diagram of typical three-indication signal location, coded track circuit

In order not to complicate the description, 100 cycles has been given as the universal track-circuit frequency for coded track circuits. However, other frequencies could be and have been used. One installation employs 91.6 cycles.

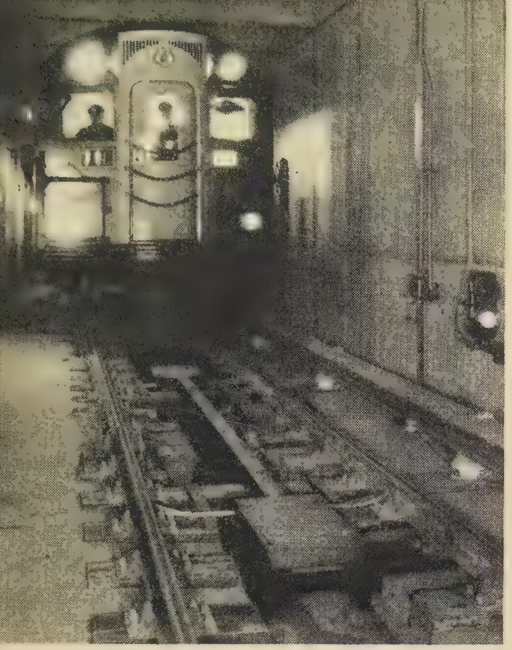
Automatic Train-Control and Cab Signals

The receiver previously described is the type required to control a three- or four-indication wayside signal. For a cab signal in a locomotive, receiving coils, attached to the locomotive just above the rails in front of the first wheels, pick up the 100-cycle current by induction. The coded energy is next amplified and then decoded as in a radio receiver and used to energize the relays which light the appropriate indications in the cab signal. These cab-signal indications duplicate the wayside signals as they are passed and retain them to the next signal, provided there has been no change in conditions ahead. Automatic block and cab signals are always governed by conditions ahead, produced by trains, or the absence of trains, and the positions of switches and turnouts. If any change occurs ahead within the control range, both wayside signals and cab signal immediately respond to it, even though the locomotive is moving forward at high speed.

Continuously controlled cab signals have an advantage over wayside signals in that the engineman receives any change in the indication at once, without having to wait



Schematic diagram of coded a-c track circuit, for three-indication signal system



Light signal, impedance bonds, automatic stop, and train, Delaware River Joint Commission

Propulsion: 600 volts, direct current. Signal current: 60 cycles

Track relay: two-element vane

until he can see the next wayside signal. If the change is to a more restrictive indication he is warned by an audible signal, such as a whistle, and can take precautions immediately; if the change is upward to a higher speed, he can promptly increase his speed, thus saving time.

The advantage to an engineman of having a continuous signal just in front of him in the cab when he is driving ahead through thick weather is apparent.

After apparatus selectively responsive to 75 code, 120 code, 180 code, and no code has been installed on the locomotive it is just one more step to add a speed-governor with electric contacts and apparatus which will affect the air brakes when the actual speed exceeds that assigned to the relative signal indication—providing automatic train control.

Centralized Traffic Control

Centralized traffic control is a system by which all the main-line track switches and signals in a district, or even an entire division, are manipulated from a central control board. It may be regarded as an evolution from power interlocking and automatic block signaling combined. As in interlocking practice, trains stop or proceed on signal indication alone, without written orders, and without regard to the priority of other trains.

The operator has before him an illuminated diagram or track model simulating all of the tracks, switches, and signals under his control, with indication lights showing the position and movement of trains as well as the position of track switches, and signal indications. Small thumb switches enable him to control signals to stop trains, or to notify them to proceed, and to operate track switches as required to divert trains into sidings or to other tracks to avoid other trains. Remote signals and switches are controlled by means of impulses generated automatically by a relay code system and sent out over a pair of wires, and return indications of the position of switches, the indications of signals, and the positions of trains come in automatically over the same wires. If several messages try to use the wires simultaneously, those coming in later are automatically stored and withheld until the circuit is free. Precedence is given to outgoing controls over incoming indications. Every safeguard developed in power interlocking and in automatic block signaling is incorporated in the system, so that no error the operator can make will do more than stop and delay a train.

An automatic device records on a moving time-chart the passage of trains over established registering points.

Outlying switches and signals are operated by local power, and the switches may be hand operated if necessary. Conveniently located telephones enable train crews to communicate with the operator if they are stopped at a signal and are in doubt about what to do. In electrified territory trolley sectionalizing switches or other apparatus can be regulated from the control panel and this is being done.

Centralized traffic control assists materially in quick handling of trains, reduces stops and delays, and increases track capacity wherever it is used.

Signal bridge showing R2 color light signals with 10-volt 18-watt lamps, impedance bonds, signal transmission line, Delaware, Lackawanna, and Western Railroad

Propulsion: 3,000 volts, direct current

Signal transmission: 2,300 volts, 60 cycles

Track relay: two-element vane

Track circuits: single rail up to 1,000 feet, double rail, 1,000 to 3,000 feet

Signal bridge showing color light signals in triangular arrangement, approach-lighted, with 10-volt 18-watt lamps, The Reading Company

Propulsion: 12,000 volts, 25 cycles

Signal transmission: 4,400 volts, 60 cycles; 4,400 volts, 100 cycles

Track circuits: single rail, up to 1,200 feet; double rail up to 6,500 feet

Track relay: centrifugal frequency polarized line control

Wayside signal indications in automatic territory: "clear"—green over green; "approach restricting"—yellow over green; "approach"—yellow over red; "stop"—red over red

Route Interlocking

Interlocking began with the use of a group of heavy levers mechanically connected to switches and signals in order to operate them from a convenient central point. The levers were interlocked to insure against setting up conflicting routes, or giving "Proceed" signals under unsafe conditions. In the course of time compressed-air cylinders or electric motors were attached to the track switches and semaphore arms, and the levers, still interlocked, merely served to actuate electric circuit controllers. Much ingenuity was shown in the design of circuits and protective devices to insure against human errors, and to prevent ill effects from failures of apparatus. Gradually a complete system of electric checking and proving, including electric track-circuit locking, grew up around power-interlocking systems, until it became evident that the mechanical interlocking between levers could safely be left out, and the control machines simplified thereby. At that stage power interlocking becomes relay interlocking, but it is still necessary to operate a sequence of control levers in order to set up a route through a network of tracks, and to restore them before setting up another conflicting route.

The latest development is route interlocking. An illuminated diagram of the track network included within the controlled area is fitted with push buttons at each end of each track route. In order to arrange all of the switches and signals for the passage of a train the operator need only push two buttons, one at the point where the train enters and one at the point where it leaves. The diagram illuminates to show the route established and the push button at the entering point lights up green when the entering signal has cleared; the lights on the push button and the different sections of track turn red as the train occupies the various sections and then go out in succession as the train passes through. The passage of a train through a route automatically sets the signal at "Stop" and leaves the switches behind it released for further use.

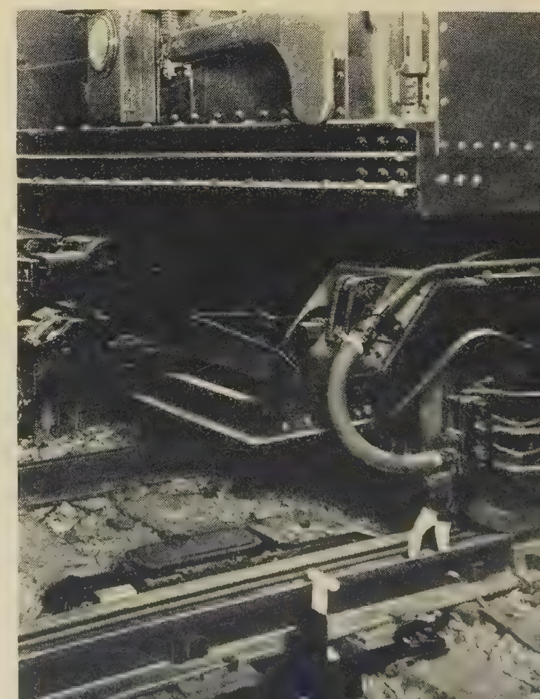
The operator can make no dangerous errors, since a route once established is locked up and automatically locks out all conflicting routes until the train passes through and releases it, or until the line-up is intentionally cancelled after a safe time interval. But if the operator wishes quickly to set up another route over that being vacated by the first train he can do so; the route is automatically released behind a train, section by section.

This method is adapted to close-lying areas and direct-wire control. There is no limit to the size of the system that can be served by one control panel, although naturally the complexity of circuits grows with the number of possible routes.

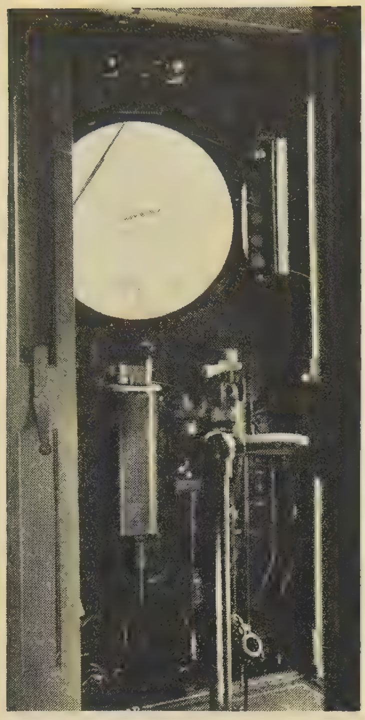
Types of Wayside Signals

The mention of railroad signals is likely to call up a mental picture of a signal with semaphore arms uplifted or outstretched, and there are many thousands of these signals doing faithful service today. But all recent developments have to do with electric-light signals.

Light signals are of various types and kinds depending



Automatic train stop with engaging arm on car, Independent Subway, New York, N. Y.



Southern Pacific cab signal on multiple-unit train operating over San Francisco-Oakland Bay Bridge

Aspects: green and 35, 35 miles per hour; yellow over green and 25, 25 miles per hour; yellow and 17, 17 miles per hour; red and 11, 11 miles per hour; purple and NS, out of service; white in conjunction with any of the first four, cautionary

upon their location and the distance from which they must be seen and understood. A subway does not require a signal of the power and range demanded on a high-speed railroad in bright sunlight.

Modern long-range light signals employ small concentrated-filament lamps carefully focused behind lenses. Although using only 10 to 18 watts, they are visible in ordinary clear weather at distances of a mile or more. These lamp-and-lens units are carefully focused in a dark room by the manufacturer before shipment and are not adjustable. The lamps are made to a precision standard and can be renewed without destroying the focus. It is common practice to equip these lamps with a secondary filament of lower wattage than the main filament, to provide against burnouts.

Several railroads have developed distinctive types of signals—for example, the position-light signal of the Pennsylvania Railroad, and the color-position light signal of the Baltimore and Ohio Railroad—but many use the color-light signal which gives its messages in colors only.

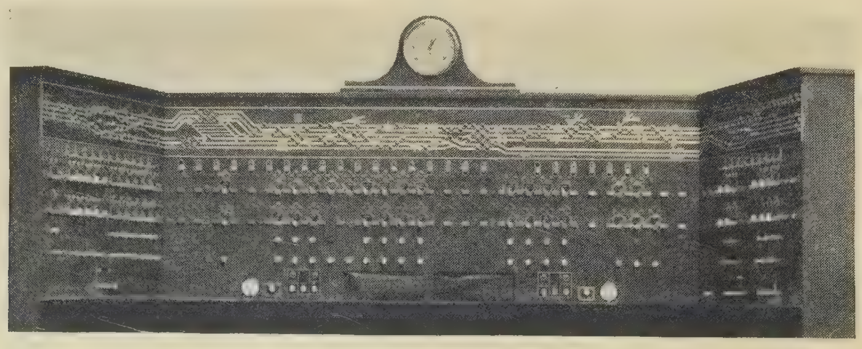
Railway light signals must meet certain requirements not filled by street traffic signals or by automobile headlights: They must not reflect other lights, even sunlight, so as to display a color not intended; they must conform to certain color standards; they must be very economical of power, since in many cases the source of power, perhaps stand-by power, is a primary battery. They must be capable of being accurately focused and carefully pointed to get the maximum effect from minimum wattage.

Signals having separate lenses and lamps for each color may not employ reflectors. However, one type, called the searchlight signal, has only one lens system and one lamp. It contains a reflector and an internal color-changing mechanism, and can display any one of three colors.

Electric railroads with catenary overhead systems and bridges supporting the catenary and power lines present a problem in locating signals to good advantage. Light signals are peculiarly suited to this situation, since they occupy little space, require infrequent attention, are not easily obscured by intervening overhead work, and have no external moving parts.

Signaling on Bay Bridge

This article should not conclude without referring to the signal work associated with the San Francisco-Oakland Bay Bridge. That installation includes coded continuous cab signals with automatic speed control at four speeds, without wayside signals between terminals, and a push-button or route interlocking at each terminal. The headway provided for is 63 $^1/_2$ seconds at 35 miles per hour. The enforced speed limits are 35, 25, 17, and 11 miles per hour. For "clear" the cab signal illuminates green with a numeral 35. For "approach restricting" another light comes on, upper half yellow and lower half green, with the numeral 25. For "approach" the cab-signal indication is yellow with numeral 17. The most restrictive indication is red with numeral 11, below which speed a train may proceed expecting to find another train ahead. If a train is proceeding at a prescribed speed and the cab signal changes downward, the motorman must immediately apply service brakes to forestall an automatic application. One-block overlap on the control of the minimum-speed indication provides stopping distance of at least one block after the cab signal has changed downward to that indication. There are of course wayside home signals and other wayside signals at the terminal interlocking plants.



Centralized-traffic-control panel at Columbia, Pa., electrified territory, Pennsylvania Railroad

A Method for Determining the Efficiencies of Small Motors

JOHN L. C. LÖF
ENROLLED STUDENT AIEE

FRACTIONAL-HORSEPOWER motors have been developed for many uses which cause their characteristics to differ widely from larger motors. Usually they are designed for constant-load operation, but some are made to have large starting torques and others to run at constant speed. Naturally these motors have a much smaller efficiency than the larger ones, and the methods used for determining the efficiency of the larger motors are not practical for the small ones.

A most common method for determining the efficiency of small motors is the Prony brake method, in which the output in watts is calculated from a speed-torque formula and the input is measured directly by a wattmeter. The torque is measured by a friction brake applied to a drum, and the speed read by a tachometer or revolution counter. The chief disadvantages of this method, when applied to small motors, are:

1. Difficulty in maintaining a constant torque on the drum.
2. Introduction of additional friction into shaft by radial pressure.
3. Difficulty in reading speed correctly, and introduction of a small load by the speed-indicating device not measured by torque indicator.

With a view to eliminating these objections, the following method was developed which does not involve either the measurement of speed or torque. It makes use of the eddy-current-brake idea, but actually measures the heat produced by eddy currents instead of torque. A brass disk about 1/4 centimeter thick and 17 centimeters in diameter has its central part removed so as to leave a flat ring about 4 centimeters in width. This disk is placed in a recess between two accurately machined bakelite plates, which completely enclose it. In the recess between the disk and the bakelite plates is a layer of felt which helps to insulate the brass disk from heat loss due to conduction to the bakelite plates. The disk is mounted on the shaft of the motor to be tested and rotates without vibration (figure 1).

Load is applied to the motor by an arrangement of four equally spaced electromagnets, the poles of which are on opposite sides of the rotating disk with suitable clearance. A direct current excites the magnets which set up eddy currents in the disk rotating through the field. The load applied to the motor is adjusted by varying the magnitude of the field. The power output of the motor is then the actual amount of heat generated by the eddy currents in the disk instead of the torque produced in the field. To determine the heat produced, the weight of the disk and its temperature rise over the interval during which the field is applied are found. The temperature rise of the disk is computed by the use of either a resistance thermometer or a thermojunction. In the first method, use is made of a groove around the periphery of the disk in which is wound about 38 ohms of very fine, enameled copper wire. The ends of the coil are attached to two binding posts on the bakelite plate. The temperature change of the disk then may be computed by measuring with a Wheatstone bridge the resistance of the wire at the start and finish of the run using the equation:

$$R_t = R_0(1 + 0.00427t_1)$$

Upon rearranging, this becomes:

$$\Delta t = \frac{R_t - R_0}{R_0}(234.5 + t_0) = \text{temperature change}$$

The second method of computing temperature rise is by the use of a thermocouple soldered to the disk. A Chromel-Alumal junction was chosen for this purpose because of its high thermoelectric power. The electromotive force produced is measured by a low-resistance microammeter, which reads temperature change by means of a calibration curve that is determined by placing the cold junction at various known temperatures while keeping the disk at a constant known temperature (figure 2).

This latter method is preferable because it is easier to operate although it requires slightly more preparation of apparatus. Hence, only this method is considered from here on. However, both methods are subject to a cooling effect which takes place during the interval between the end of the time of application of magnetic field and the reading of the recording instrument. This is due to slow conduction of heat through the insulation (figure 3). This difficulty is readily overcome in the following way: The microammeter deflection is recorded for successive small time intervals, which in this case were 15 seconds.

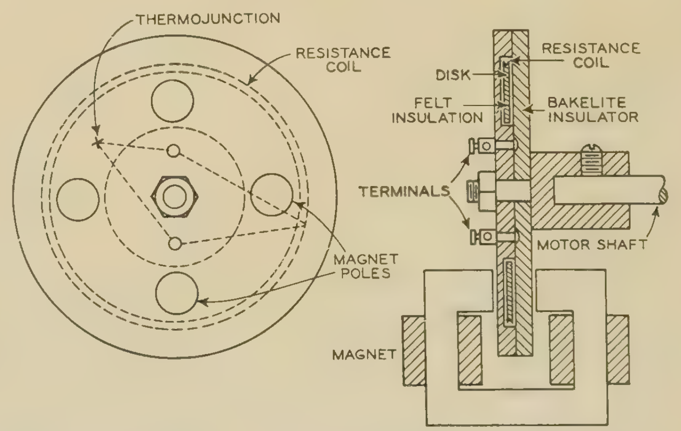


Figure 1. Diagram showing arrangement of apparatus for measuring efficiency by the eddy-current-heat method

This paper received the AIEE national prize for Branch paper for the academic year ending June 30, 1938.

JOHN L. C. LÖF received the degree of bachelor of science in electrical engineering from the University of Denver and is now a graduate student at the Massachusetts Institute of Technology, Cambridge.

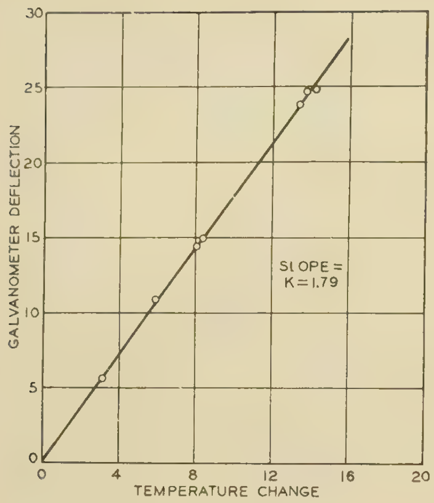


Figure 2. Calibration curves for Chromel-Alumal thermojunction

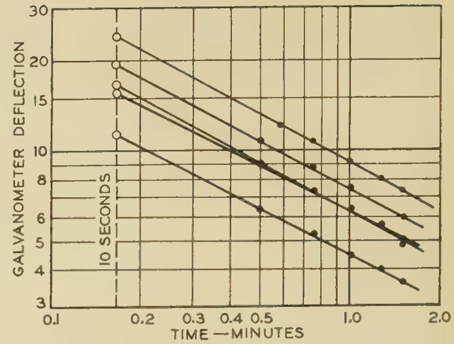


Figure 4. Typical log-log curves for determining deflection of temperature-measuring galvanometer at time of removing magnetic field

Then these results are plotted on log-log graph paper using the zero-time point as the time at which the magnetic field was first applied. Series of tests covering various time intervals show conclusively that these log-log curves are straight lines, all having the same slope over the range considered; therefore, by drawing a straight line through the points obtained, the expected theoretical deflection at the time of removing the magnetic field is obtained by extrapolating the line (figure 4). Then the true temperature change is found from the calibration curve. However, this lack of perfect insulation and the resultant cooling of the disk should not be considered as a serious disadvantage because this prevents the disk from becoming overheated after many trials.

After the true rise in temperature has been determined, the heat output generated is easily computed from the equation:

$$W_0 = \frac{M \times C \times \Delta t}{0.239 \times T} \text{ watts}$$

where

Δt = temperature rise
M = mass of disk
C = specific heat of metal
T = time of applying field

Experimentation has shown that the best time interval for applying the magnetic field is about ten seconds because it is short enough to prevent any appreciable loss of heat from the disk while running and still long enough to permit accurate timing. Also, this short time does not heat the motor appreciably on heavy overloads. The 10-second period may be timed accurately with a stop watch. A field of about 70,000 maxwells is found to be sufficient for a $^1/_{15}$-horsepower motor.

An efficiency curve may be obtained by varying the exciting current of the magnets so that the eddy-current heat output will be varied. The efficiency, of course, is determined by computing the ratio of output to input, the output watts being computed as described and the input watts determined by a wattmeter (figure 5).

This method as developed could easily be applied in industry, as the equipment is neither complicated nor expensive. Testing on heavy overloads may be done very easily because the time of loading is very short and there are no heavy radial forces acting to introduce large amounts of shaft friction. Also, the efficiency of a motor at any temperature can be found readily as the method causes very little change in the motor temperature during the short time intervals used.

The accuracy of this method is probably equal to that of other methods because there is little opportunity for introducing errors. Being entirely independent of speed or torque measurement, the method is not subject to inaccuracies here. Practically no additional friction is added to the motor with increase of load, and the motor does not become heated appreciably during the test. Consequently, the values of efficiencies found by this method might be expected to be slightly higher than those obtained in other ways. Also, the motor runs entirely free, and the disk introduces only slight windage loss. These advantages indicate that this is a practical and promising method for finding efficiencies of small motors.

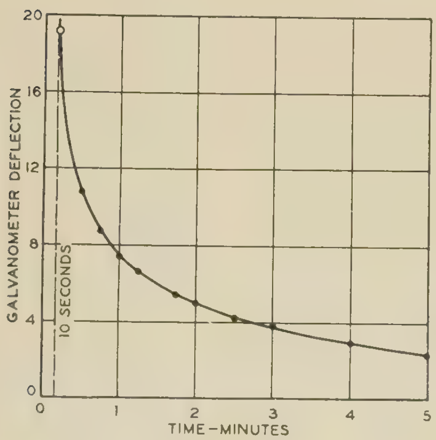


Figure 3. Cooling curve for brass disk

Time of application of field—10 seconds; output—104.4 watts

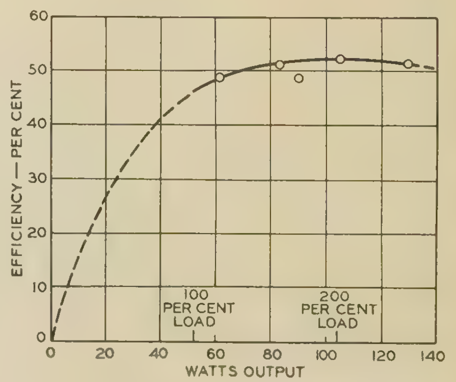


Figure 5. Efficiency of a 1/15-horsepower split-phase resistance motor, as determined by the eddy-current-heat method

The Electric Strength of Fibrous Glass

A. GEMANT F. A. GLASSOW

The ideal, and probably future, use of fibrous glass for electrical insulation is without an organic filler. Therefore, it is important first to know its electric strength in unimpregnated condition. Test results show its high qualities at elevated gas pressures and temperatures.

THE advantage of inorganic electrical insulators as compared with organic ones has been frequently emphasized by investigators, mainly with regard to their stability against oxidizing and other deteriorating agents. Unfortunately, one of the chief organic insulators, namely paper, valuable for its flexibility and porosity, could not until recently be replaced by an inorganic material. The introduction in the last few years of textile glass seems to be a promising step toward filling this gap. Its importance and usefulness is described in several recent publications.[1–4]

The chief use of fibrous glass at present is in combination with varnishes and resins, since the electric strength of the textile alone is too low for most purposes. It should be pointed out, however, that the essential advantage of the glass, namely its inorganic nature, is lost in this combination. The ideal insulator will be textile glass, impregnated with the inorganic resin of the future.

It is not meant by this statement that the organic material will affect in any way the deterioration of the glass fiber itself; also the combination of glass with varnish is admittedly superior to the combination of cotton or asbestos with varnish. But the full and theoretically maximum advantage of the fiber glass can be obtained only in combination with an inorganic filler.

In face of this requirement it is important to gather more information on the dielectric breakdown strength of glass cloth alone, without its organic filler. It is known already that the strength is practically the same as that of an air gap of equivalent thickness. It was the authors' purpose, therefore, to extend this information with regard to the effect upon the breakdown strength of several factors, such as the density of the woven structure, the type of voltage, whether alternating or continuous, the air pressure, and the temperature. This article presents the results of this research, together with some conclusions to be drawn.

Apart from the necessity of knowing the behavior of the glass textile without an organic filler, this information might be of direct use in the field of modern air cables,[5–6] consisting of paper and air under elevated pressure. The use of fibrous glass combined with air at high pressure would then be a first model of a purely inorganic "impregnated" insulation.

General Results

Four different makes of textile glass were used in this investigation, denoted by numbers 1 to 4; 1 and 2 refer to cloths, and 3 and 4 to glass tapes. The corresponding specific weights are 0.8, 1.2, 0.6, and 0.3 pounds per square yard, and the corresponding thicknesses 20, 30, 10, and 5 mils. In the breakdown experiments, however, one plane and one spherical electrode were used, and the actual separations, due to compression, were somewhat smaller than the nominal thicknesses of the test specimens. In preparing the curves the actual separations were used, as determined by means of a plane and sphere micrometer.

The samples were not specially conditioned for the tests, as some measurements showed that specimens dried at 120 degrees centigrade did not yield higher values for their electric strength.

In the a-c tests the voltage was measured by means of a precision transformer of ratio 120 to 1 and a voltmeter, and in the d-c tests by means of a liquid high-resistance potentiometer in connection with a 750-volt static voltmeter. Short-time tests were carried out throughout the whole work.

The general results of such measurements are indicated in figure 1, a-c data being peak values. Each point represents the average from several individual data. The dotted line represents the values of a corresponding air gap, the data being taken from the literature.

In order to interpret the results, the following facts should be recalled. In paper, or in a textile like glass cloth, the insulation consists of a large number of thin layers of the solid, connected in series, alternating with similarly narrow air gaps. The field strength in the air is then higher than it would be in air alone, because of the higher dielectric constant of the glass. This circumstance will

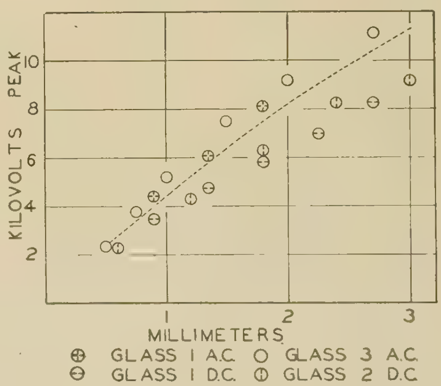


Figure 1. Breakdown voltage of fibrous glass versus thickness of layer

Dotted curve is for an air gap

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The authors are indebted to Professor Edward Bennett (A'01, F'18) of the University of Wisconsin for facilities placed at their disposal.

For numbered references see list at end of article.

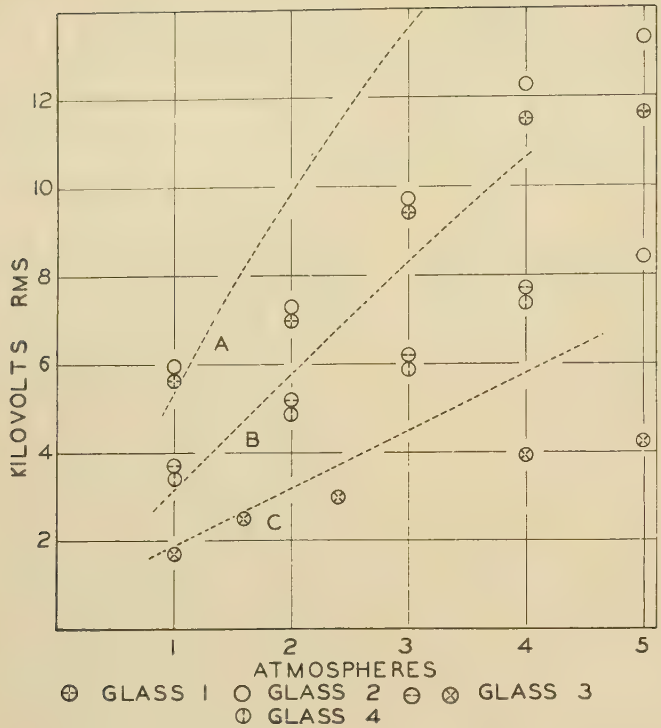

Figure 2. Effect of gas pressure on the a-c breakdown voltage of fibrous glass

A—Glasses 1 and 2; thickness of layer 1.8 millimeters
B—Glasses 3 and 4; thickness of layer 1.0 millimeter
C—Glass 3; thickness of layer 0.5 millimeter
Dotted curves are for air gaps

tend to reduce the electric strength of the structure, as compared with air.

Ionization and subsequent arcing, however, occurs in the narrow air gaps, the ignition field strength of which increases considerably with decreasing separation. The cross section of the actually open air channels is also very small, and it is known that the electric strength of such channels is higher, as compared with an open air gap of the same separation.[7] These circumstances will tend to increase the strength of the textile, as compared with air.

Thus the dielectric strength of unimpregnated paper is twice to three times as high as that of a corresponding air gap, and it increases with the density of the paper. This is in accord with the foregoing explanation.

The results in figure 1, however, do not indicate such a pronounced effect with fibrous glass. The reason for this is that the dimensions of the interspaces in fibrous glass are some two orders of magnitude larger than in paper. The a-c breakdown voltages lie a little above the air curve, and the d-c voltages somewhat below. This fact, too, can be explained on the foregoing basis. The field distribution for alternating current is controlled by the dielectric constants of the two components (glass and air), but for direct current, by their conductivities. The former ratio is about 5, whereas the latter is certainly larger; the divergence between the d-c values and the a-c maximum ones is, therefore, easily understandable.

The density of the structure was somewhat closer for glasses 3 and 4 than for glasses 1 and 2 (compare the figures for weights and thicknesses as given previously). The values obtained with glass 3, however, are only slightly higher than those obtained with glass 1. The reason is that a pronounced difference, due to texture, cannot be expected in this range of relatively large porosity.

It follows from these observations that a denser structure of the glass textile would be desirable from the standpoint of its electrical application, particularly if the glass were to be used without an impregnating material.

Fressure Effect

The next point was to find out the effect of the air pressure upon the electric strength of glass cloth. Previous research on paper[7] has revealed that the voltage-pressure curves for paper and air cross each other. Normally the curve for paper is situated above that for air, but beyond a certain pressure the paper becomes a worse insulator than air. The reason for this effect is that the breakdown strength of air is a function of separation times pressure; the beneficial effect resulting from the thin interstices, therefore, gradually decreases when the pressure is being increased.

The experiments on glass cloth were carried out in a cylindrical cast-iron tank with a lid bolted to the main body. The lid contained a porcelain bushing, serving as the high-voltage lead, the grounded lead being connected to the cylindrical body itself. Compressed nitrogen was used to provide the necessary pressure, the magnitude of the latter being read on a manometer attached to the pressure pipe.

Figure 2 shows the results obtained with alternating current, for glass cloth of three different thicknesses. The air-gap curves corresponding to each of these thicknesses are shown as dotted lines.

The values for glass lie only a little above the air curve for the normal pressure of one atmosphere, but for higher ones they all lie below the air curve, though the increase of the electric strength with pressure is very pronounced

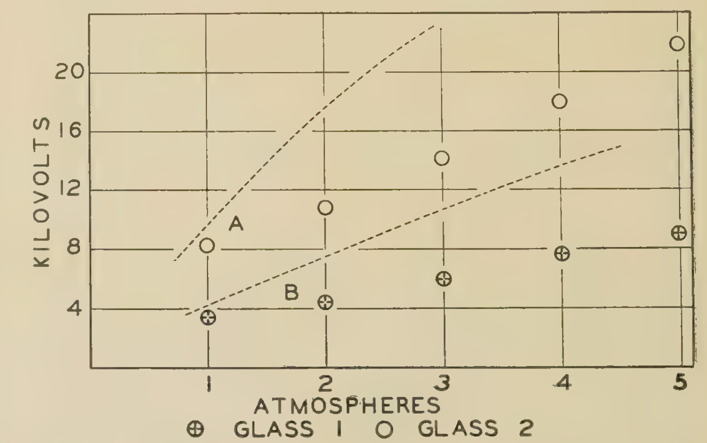

Figure 3. Effect of gas pressure on d-c breakdown voltage of fibrous glass

A—Glass 2; thickness of layer 2.4 millimeters
B—Glass 1; thickness of layer 0.9 millimeter
Dotted curves are for air gaps

and nearly linear. The crossing of the curves occurs between one and two atmospheres pressure, due to the high porosity of the fibrous glass. Nevertheless, the latter could well be used in this combination, and would be certainly superior to paper in that occasional ionization will do less damage to glass fibers than to organic cellulose fibers.

Figure 3 shows results of some d-c tests. The air gap curves again are indicated, and the trend of the data is similar to that with alternating current. The divergence between the glass and air curves is here even more pronounced, and crossing apparently takes place below the normal pressure of one atmosphere.

Temperature Effect

One of the chief advantages of fibrous glass is the possibility of its being used at higher temperatures. Thus some puncture tests have been carried out from room temperature up to 350 degrees centigrade. A small electric oven was used for this purpose, a porcelain bushing at the top serving as the high-voltage lead. An asbestos-insulated Nichrome wire of about eight-ohm resistance provided the heating element. The electrodes were of brass, the bottom one being plane and the top one spherical.

Figure 4 shows some of the results, a-c data being effective values. The corresponding dotted air curves start

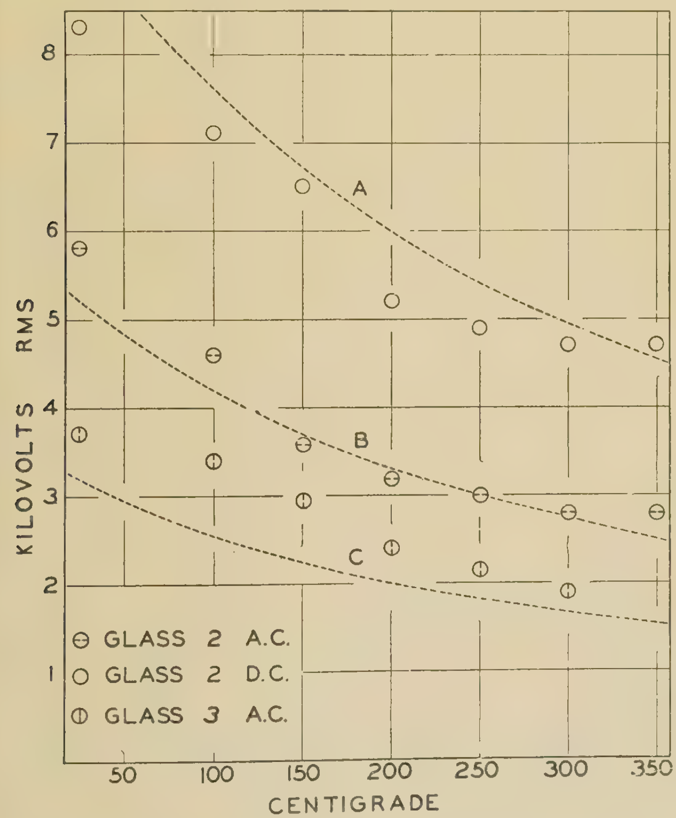

Figure 4. Effect of temperature on breakdown voltage of fibrous glass

A—D-c test on glass 2; thickness of layer 2.4 millimeters
B—A-c test on glass 2; thickness of layer 1.8 millimeters
C—A-c test on glass 3; thickness of layer 1.0 millimeter
Dotted curves are for air gaps

Table I. Puncture Values in Kilovolts (Effective) of Oil-Free Glass Fabric 4; Thickness 0.7 Millimeter

Temperature (Degrees Centigrade)	Washed Tape	Heat-Treated Tape	Air-Gap Value
25	3.05	3.1	2.4
150	2.65	2.6	1.7
350	2.1	2.05	1.15

with the known data for room temperature, while the curves themselves are calculated on the basis that the electric strength is proportional to the density of the gas, that is, to the reciprocal of the absolute temperature, if the pressure is constant.

In agreement with the previous results, the d-c values lie somewhat below, and the a-c values above the respective air curves. They generally follow the latter quite closely, thus indicating that glass textile is, indeed, a very useful insulator for higher temperatures, since it does not deteriorate, and that the decrease of the electric strength of unimpregnated glass with increasing temperature is due only to the normal behavior of the air in the interspaces.

Fibrous glass contains a small fraction of mineral oil, which is used as lubricant in the weaving process. However small this fraction might be, its presence is certainly not desirable, since it will oxidize at higher temperatures, thus to a certain extent obviating the high heat resistance of the cloth itself. The fact that the oil is situated on the surface of the fibers is a special disadvantage, as the (internal or external) surfaces represent the spots of least resistance for any dielectric.

The deterioration of the oil at elevated temperatures can easily be seen from the brown discoloration the fabric assumes when heated above 150 degrees centigrade. This burning of the oil might also occur if the glass cloth were impregnated with a resin which itself withstands that temperature.

In order to find out whether this small proportion of oil has any detectable influence upon the electric strength of the glass cloth, it was necessary to compare the normal fabric with an oil-free specimen. There are two ways to remove the traces of oil from the fabric, namely, by washing the cloth with an alkaline soap solution, or by heating it to 450 degrees centigrade, thus burning off the oil completely.

Glass tape 4 was, in fact, a specimen furnished by the factory in oil-free condition, partly washed, partly burned off. A number of single layers having a total thickness of 0.7 millimeter were tested by means of alternating current, and the results for three different temperatures are shown in table I, together with the corresponding values for an air gap.

The improvement, as compared with air, seems decidedly greater than for normal glass, as shown in figure 4. The 1.0-millimeter curve (*C*) for instance, shows an improvement of 30 per cent for 150 degrees centigrade, as compared with 53 per cent for the oil-free samples.

In order further to verify this result, the oil was burned

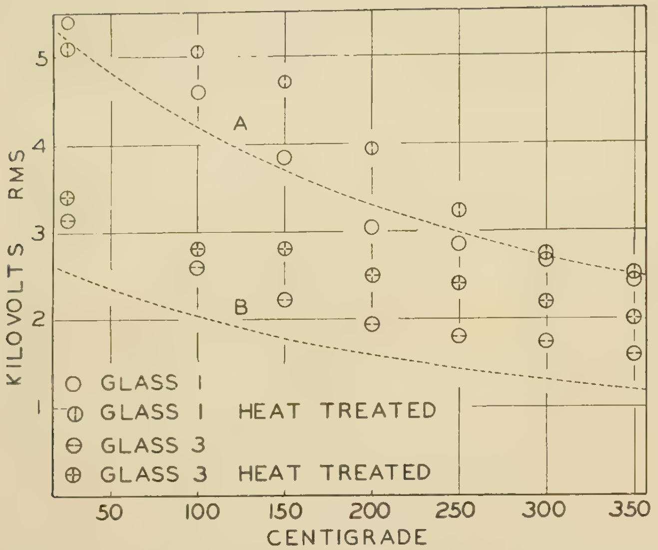

Figure 5. Effect of temperature on a-c breakdown voltage of treated and untreated fibrous glass

A—Glass 1; thickness of layer 1.8 millimeters
B—Glass 3; thickness of layer 0.75 millimeter
Dotted curves are for air gaps

off some samples of glasses 1 and 3, and direct comparisons were made. The heat treatment was completed in two phases: First the glass was heated to 300 degrees centigrade under a reduced pressure of about 15 millimeters of mercury, in order to evaporate the oil to a large extent. Next the glass was heated to 450 degrees centigrade under normal pressure, to burn off any remainder.

The results of a-c tests on these samples are shown in figure 5. The difference between the untreated and heat-treated samples is quite pronounced. The divergence is certainly due to the presence or absence of the oil, as shown by the fact that the difference is pronounced especially between 150 and 200 degrees, that is, in the range in which the oil begins to oxidize. It can be concluded that a removal of the oil from the cloth would certainly improve its quality.

According to our experience the heat treatment, if not performed carefully, is likely to make the glass fibers brittle. The washing process might prove more feasible as an industrial operation.

Leakage Tests

To supplement the foregoing results, a few measurements of the leakage resistance of fibrous glass were made, in following up its variation with temperature.

Because of the minute currents, a d-c amplifier was used, incorporating an electrometer tube in combination with a portable galvanometer. The principle of grid-current compensation was used. The grid resistance was a picric-acid liquid resistor of 600 megohms.[8]

The glass cloth (number 1), ten by ten centimeters in area and 0.5 millimeter thick, was placed between two plane brass plates in an electric oven. The voltage, supplied by dry batteries, varied from 4.5 to 90 volts. The measured total resistance of the cloth was multiplied by the factor 2,000, in order to obtain the resistivity in ohm-centimeters.

Figure 6 shows the result, the Briggs (base ten) logarithm of the leakage resistivity (ρ) being plotted against the reciprocal of the absolute temperature, since this type of plotting is most likely to give straight lines. The lower curve refers to the original cloth, and the upper one to a sample heat-treated according to the process just described. Both cloths were unconditioned.

The untreated cloth was measured from 25 up to 125 degrees centigrade (not further, in order not to burn the oil) and then back. The heat-treated one was measured from 60 up to 160 degrees centigrade and then back (the apparatus was not sensitive enough for this cloth near room temperature). Upward and downward points are sufficiently close, as can be seen.

The essential result of this measurement is the superiority of the heat-treated cloth as compared with the original one, its leakage resistance being one to two orders of magnitude higher. The same result was obtained by having both the untreated and treated cloth dried at 125 degrees centigrade for a few hours previous to the measurements; all resistance values increased from three to ten times, with the difference between the two cloths persisting. It is easy to understand that a thin film of oil on the surface of the fibers will increase the conductivity, partly by facilitating the retention of moisture. Thus, the conclusion stated in the previous section is here confirmed and explained. The higher conductivity of the untreated fibers will shift the field strength ratio between the two components in favor of the air, thus causing a reduction of the breakdown strength.

Apart from this difference it is essential to point out that both cloths have a very high and satisfactory leakage resistance even at higher temperatures, indicating the usefulness of this new material for electrical purposes.

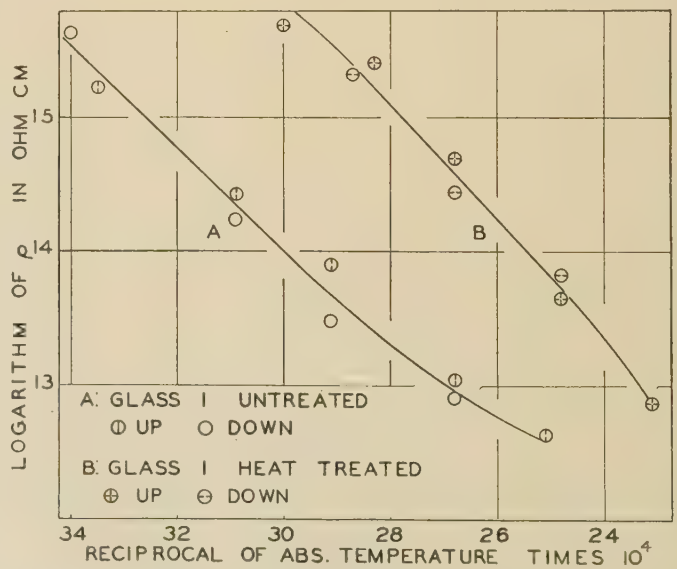

Figure 6. Effect of temperature on leakage resistivity of untreated and heat-treated fibrous glass

Summary

This article presents the results of research into the electric strength of unimpregnated fibrous glass. The chief results are the following:

1. The (maximum) breakdown voltages for alternating current are higher than the corresponding values obtained with direct current.

2. The density of the texture has only little effect on the electric strength. Further increase of the density would be desirable.

3. The electric strength increases linearly with pressure (measured up to five atmospheres) though the values are lower than those corresponding to an air gap of same separation.

4. Measurements up to 350 degrees centigrade indicate satisfactory electric strength even at higher temperatures, although the puncture values decrease with increasing temperature. Heat-treated and washed samples, from which the small proportion of oil is removed prove superior at higher temperatures.

5. The leakage resistance (measured up to 160 degrees centigrade) is very satisfactory (10^{16} to 10^{13} ohm-centimeters) decreasing with increasing temperature in the usual manner, oil-free samples again proving superior to the untreated ones.

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A Bridge for Separating the Components of Traveling Waves

by which the incident, reflected, and standing waves of voltage on a transmission line may be separated for simultaneous and independent measurement

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THE USE of repeater circuits for amplifying voltage waves traveling in two directions on a telephone transmission line is a routine procedure. The so-called 22-type repeater of the Bell Telephone System accomplishes this by actually picking out the wave traveling in one direction, amplifying it, and then inserting it back into the line in the same direction. The wave traveling in the opposite direction is handled in the same manner without interfering with the action of the first wave.

For purposes of instruction or test it is often desirable to separate the incident and reflected waves on a transmission line and to have a method of measuring separately not only these waves but the total or standing wave of voltage. In the telephone application the wave separation accomplished by the 22-type repeater is merely incidental, the important practical result being the energy amplification. When, however, it is not necessary to amplify but only to examine the wave components separately, the amplification can be eliminated, with a great gain in directness, accuracy, and simplicity. A bridge of the kind to be described has been in successful use for several years in the communication laboratories of the electrical-engineering department at the University of Minnesota and at Lehigh University. It has fixed impedance arms, and when used with the artificial telephone line for which it was designed permits the separation and measurement at a fixed frequency of the incident, reflected, and standing voltage waves at any point on the line and for any line impedance termination.

Consider the Wheatstone bridge in the form of figure 1. All branches are of equal impedance Z_o. If a source of electromotive force is inserted at X, no voltage will appear across BC since the bridge is balanced. The voltages appearing across branches AB, BO, OC, and CA will all be equal. In the same manner, if an electromotive force is introduced at y, the effect across branch BO will be nil. The voltage appearing across BC in this case will be one-half the voltage across AC.

Let us now replace the impedance Z_o in branch AC with a transmission line of characteristic impedance Z_o ter-

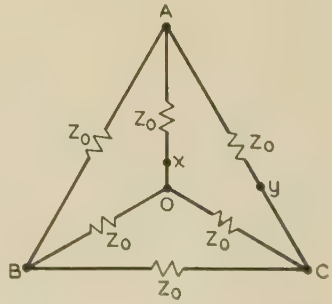

Figure 1. Schematic diagram of Wheatstone bridge

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minated in a load Z_R such that $Z_R = Z_o$ (figure 2). Under such conditions the impedance looking into the line at yy' will be Z_o and the bridge will remain balanced as before. Let the arm AO be replaced by a generator of internal impedance Z_o. Then $E_{BC} = 0$, and $E_{BO} = E_{yy'}$. The voltage $E_{yy'}$ is the incident voltage on the transmission line.

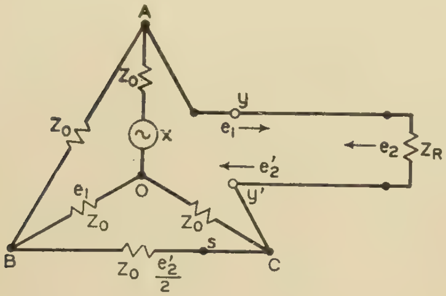


Figure 2. Schematic diagram of resolving bridge

If now the load impedance Z_R be changed from the value Z_o to some other value, the change will produce a reflected wave e_2 traveling back to yy'. The reflected wave arriving at yy' may be considered in place of the actual change in impedance produced there by the change in load impedance Z_R. As explained previously, any voltage appearing at yy' will produce no effect on the branch BO. The voltage across BO, therefore, will remain the same as the incident voltage on the line. The reflected voltage e_2' will appear across the two parallel branches, ABC and AOC. Inspection will show that one-half of the reflected voltage appears across BC. The separation of incident, reflected, and standing voltages, therefore, is accomplished as follows:

$E_{BO} \equiv$ incident voltage, e_1
$2E_{BC} \equiv$ reflected voltage, e_2'
$E_{yy}' \equiv$ standing voltage, $\dot{e}_1 + \dot{e}_2'$

If the phase shift along the line is known, the incident and reflected voltages may be combined vectorially to obtain the resultant voltage which then may be checked against $E_{yy'}$. The vector relationship between E_{BO} and E_{BC} may be had by measuring E_{OC} and drawing the voltage triangle. This is, however, not an absolute method. The cathode-ray oscillograph may be used to better advantage in measuring the phase shift between the two voltages.

The problem of obtaining an oscillator or generator of internal impedance of value Z_o is not difficult, since one may add a suitable network to any oscillator to make the impedance looking into the combination equal to Z_o.

If one desires to measure the ratio between the incident and reflected waves of voltage at various points along a line, it is necessary only to connect between yy' and the termination a number of sections of line corresponding to the distance between the point at which the values are desired and the termination Z_R. In this manner one may cover the whole line from generator to load by making the first measurement with the complete line in and gradually removing the sections one by one until only the terminating impedance Z_R remains.

Multiple reflections will not occur since the reflected wave e_2' meets an impedance Z_o upon arriving at yy' and is completely absorbed.

The resolving bridge should prove of value to investigators concerned with studying conditions that cause reflections to occur on transmission lines. Thus a cathode-ray oscillograph connected across branch BC (figure 2) can be used to illustrate only the reflected wave appearing at yy'.

Use of the bridge, however, is not confined to the application just described. Many other possibilities may suggest themselves to the reader. For example, a relay connected in the branch BC (with proper compensation for its impedance) would be actuated only by the return wave, and thus the action of this relay could be controlled entirely by the impedance at the termination of the line. In this manner a sensitive, remote-control device is obtained, especially when used with lines of small attenuation.

Another useful application of the bridge is found upon observing that an impulse originating at X (figure 2) will traverse the line twice before registering at S. Thus a signal at X may be delayed from arriving at S by any desired amount of time by adjustment of the length of the transmission line.

Illumination Notes*

Incandescent-Lamp Ratings. A movement is under way in continental Europe to change the ratings of incandescent lamps from watts to decalumens. The adoption of such ratings would result, when further increases in efficiency are achieved, in giving the customer the same light at lower power cost, instead of more light for the same power cost, as is now the case in the United States under the wattage ratings. Were adequate levels of lighting intensities now generally prevalent, the change in rating would seem logical; but since in fact such levels are still far from attainment in most lighting installations, there would seem to be a strong argument in support of the contention that such change in lamp ratings would be premature.

The Brightest Stadium. The stimulus of the "better light, better sight" campaign is influencing the baseball stadium. The Philadelphia Athletics are playing night games this season under new high intensity levels of floodlighting. Both in the infield, lighted with 135 foot-candles, and in the outfield, with 100 foot-candles, players and spectators may follow the ball with ease. The engineers of the Westinghouse Electric and Manufacturing Company, who designed the installation, estimate that the total amount of light would be sufficient to light a highway from Philadelphia to Cleveland with an intensity corresponding to present standards.

Contributed for the AIEE committee on production and application of light by L. A. Hawkins (A'03, M'13) executive engineer, research laboratory, General Electric Company, Schenectady, N. Y.

Marion A. Savage—1938 Lamme Medalist

"For able and original work in the development and improvement of mechanical construction and the efficiency of large high-speed turbine alternators"

AWARDED annually to a member of the AIEE "who has shown meritorious achievement in the development of electrical apparatus or machinery," the AIEE Lamme Medal for 1938 was presented during the Institute's recent combined summer and Pacific Coast convention at San Francisco, Calif., to Marion A. Savage (A'21) designing engineer, General Electric Company, Schenectady, N. Y. At the presentation ceremonies Medalist Savage's achievements were reviewed by P. M. Downing (A'98, M'08) first vice-president and general manager, Pacific Gas and Electric Company, San Francisco, Calif., and past vice-president, AIEE. Following Mr. Downing's address, President John C. Parker made the presentation. Because ill health prevented Mr. Savage's attendance, the medal was presented to P. L. Alger (A'17, F'30) staff assistant to engineering vice-president, General Electric Company, Schenectady, N. Y., who received it in behalf of the medalist and read his response. Essentially full text of Mr. Downing's address and of Medalist Savage's response follows on this and the succeeding two pages.

Accomplishments of Medalist Savage

P. M. DOWNING, Member AIEE

Upon the face of the Lamme Medal is inscribed a pungent aphorism: "The engineer views hopefully the hitherto unattainable." This might well have been written to describe the career of Marion A. Savage, medalist for the year 1938, whom we honor today.

Savage is such an engineer. During the 33 years that have passed since he emerged from college to take up his life work he has been driving steadily forward, conquering heights of accomplishment hitherto unattainable. No man could have done what he has done without the ability to "view hopefully," the difficult problems he has tackled and solved.

To him the electrical industry owes a heavy debt for what is so inadequately described in the medal award as "able and original work in the development and improvement of mechanical construction and the efficiency of large, high-speed turbine alternators."

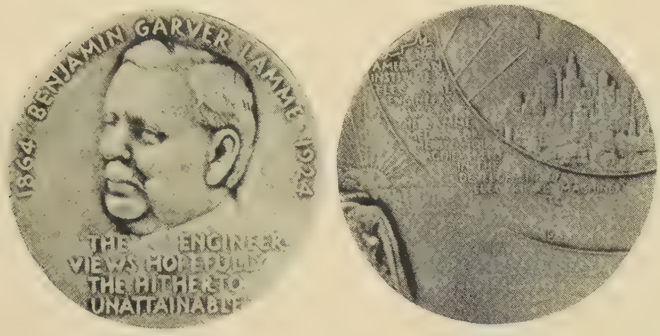
How great that debt may be is as yet not fully determined. The trend toward more general installation of large steam-turbine generating units is definite, even in areas like the Pacific Coast where water power in the past has dominated the generating field because of its low operating cost. It may be that the high-speed turbine alternators developed by Savage and his associates, when operated with cheap fuel, will bring the cost of electric-power production to still lower points than those already reached. The influence of steam generation upon the future of the electric-utility industry can only be surmised at this time. It may indeed prove to be the deterrent that will preserve the integrity of the industry against further encroachments of subsidized publicly owned hydro-electric projects.

Marion A. Savage was born in Walterboro, S. C., in 1885. He attended Clemson College in his native state and, in 1906, was graduated with the degree of bachelor of science in electrical engineering. From the Clemson campus he went directly into the service of the General Electric Company as student engineer. His postgraduate experience covered $2\,^1/_2$ years—spent first at Pittsfield, Mass., on transformer tests and then at Schenectady, N. Y., where he built a broad and solid technical foundation in marine equipment, induction and railway motors, generators, turbines, switchboards, train-control equipment, and other apparatus.

With this preliminary training behind him, the young engineer was assigned, in 1909, to the a-c engineering section of the Schenectady works, and there he began the

studies and the intensive labors that year after year have added to his record of accomplishments.

In 1923 he was placed in charge of the turbine generating department of the company and in 1931 was appointed designing engineer of the department. In the same year Mr. Savage received a Coffin Foundation certificate, conferred, in the language of the award, "in recognition of his outstanding skill as a designer, as notably demonstrated in the design and development of large steam-driven alternators."



The AIEE Lamme Medal

Revolutionary advances have been made in the design of large turbogenerators since Mr. Savage took charge of his company's production. Speeds have been increased from 1,200 and 1,800 rpm to 3,600 rpm; maximum rating has been raised from 50,000 kva to 200,000 kva. In 16 years this one engineer has been responsible for the design of 398 turbine generators having a total rating of 12,970,907 kva. Several of the machines produced under his direction had, at the time, greater output rating than any that had ever theretofore been constructed.

The problems met by Savage and his associates during this period of rapid development were not merely of an electrical nature. Their solution involved also refinements and innovations in numerous branches of mechanical engineering and of metallurgy. This list of accomplishments is long. Among them may be mentioned:

Application of the enclosed cooling system to turboalternators, substitution of hydrogen for air as the cooling medium, and numerous devices to increase the efficiency of the cooling system.

A novel hydraulic pressing device used in assembling the spindles and cylinder of large field bodies of turbine generators.

A two-part generator frame design which permits shipment of the inner frame with complete assembly of armature core and winding.

A twisted-lead armature-winding-transposition design which secures low eddy current losses in large armature windings with small numbers of turns.

The development of an end twist in stator windings to equalize the impedance of the different strands in the conductors of the winding.

In co-operation with the metallurgists and steel manufacturers, Savage has brought about improvements in forgings to meet the severe mechanical stresses imposed in high-speed generators.

Other innovations include a new method for stretching metal cylinders, the adaptation of aluminum field windings to 3,600-rpm machines, and grooving of the rotor surface to reduce eddy currents. As an inventor, Mr. Savage is credited with patents covering especially devised flow meters, liquid-filled cooling pads, a design for a two-part generator frame which permits the shipment of a completely assembled turboalternator of much larger size than otherwise would be possible, and many other improvements valuable to the industry.

The foregoing are only a few of the accomplishments of this one engineer. By making available high-speed steam-driven generators of large capacity, he has conferred substantial benefits upon the electric-utility industry and upon all users of electricity. Cost of equipment and of power-station buildings per kilowatt of capacity has been sharply reduced. Vertical compound turbine generators built under his direction have made possible substantial savings in the cost of foundations and buildings.

During his busy life, most of which has been devoted to the heavy responsibilities imposed upon him, Mr. Savage has found time to share the results of his researches with the engineering profession. He has contributed numerous articles to this Institute and, in 1930, presented a paper before the Second World Power Conference at Berlin entitled "Economic Developments in Turbine Generators in the United States."

In thus briefly outlining the career and work of Marion Savage, I cannot refrain from speaking of the unfailing courage and enthusiasm with which he has carried on during recent years, in spite of the heavy handicap of illness. He could not be with us today for this reason, but in his home at Scotia, N. Y., I hope he will sense in some measure, the admiration and the high respect in which he is held by his fellow engineers of this Institute.

He richly merits the award conferred upon him today—not only as an outstanding engineer of distinguished accomplishments, but as a man.

A Good Designer Must Be a Good Prophet

MARION A. SAVAGE, 1938 Lamme Medalist

All engineers who have to design electrical machinery honor the name of Benjamin G. Lamme, who did so much to advance the designing art. It was my good fortune to know Mr. Lamme personally. His kindly nature, remarkable memory, and keen mind were an inspiration to a young engineer. In accepting this medal given in memory of his achievements, I do so not as a personal tribute, but rather as a tribute to a small but loyal group of men who have worked with me in my own company, as well as to those in other companies who have done so much to bring the turbine generator to its present state of development.

There is born in all of us a desire to build something, whether it be a mouse trap or a monolith. It makes no difference to the builder whether the thing he builds becomes the butt for all of the family jokes or not. If he has

labored long and brought forth something, it is a thing of beauty, in which he takes secret pride. In your professional designer this creative desire has been fostered to the point where it becomes a vocation rather than an avocation. His satisfaction in accomplishment is none the less keen. His greatest reward comes when, after laboring over some design for a year or more, and the thing is finally built, he finds that all of its component parts fit together, with none missing and none left over, and that it performs the task for which it was designed.

AIEE Lamme Medalists

1928	Allan B. Field
1929	Rudolph E. Hellmund
1930	William J. Foster
1931	Guiseppi Faccioli
1932	Edward Weston
1933	Lewis B. Stillwell
1934	Henry E. Warren
1935	Vannevar Bush
1936	Frank Conrad
1937	Robert E. Doherty
1938	Marion A. Savage

It has always seemed to me that a good designer must be, more than anything else, a good prophet—that is, he must prophesy not only what it is possible to do in the way of technical performance, but he must predict what his own organization can do in detail, and promise that performance in a given time and with a given amount of money.

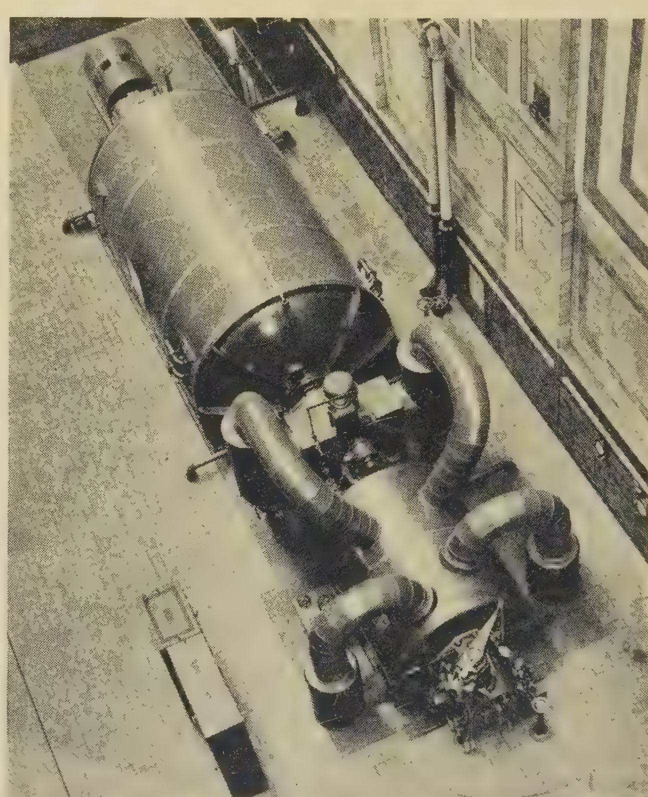
A designer has one advantage over other kinds of prophets, as he deals with materials and natural laws which are definite and will always repeat themselves. In the words of a metallurgist friend, "Steel and copper never lie." It is often difficult to read the message that a piece of metal has to tell you, but you can be sure that whatever it says it will not go back upon. Any who enjoy crossword puzzles will appreciate the pleasure a designer takes in solving the riddles posed by the varied and often unexpected behavior of the materials and structures with which he has to deal. In a large turbine generator of modern design, the variety of these problems is very great, and the opportunities for creative and enjoyable work are correspondingly large.

A designer must also be somewhat of a prophet in predicting the trends in design, and what the public will desire, several years ahead of the actual demand. Quite frequently the ground work on a design may be laid years before the actual building of the machine. This is illustrated in the development of hydrogen cooling for turbogenerators. This form of cooling was first suggested in 1922, and considerable developmental work was done. By the year 1929 so much progress had been made, and we had become so enthusiastic over it, that in a paper before the AIEE Pacific Coast Convention of that year we threw all caution to the winds and made the following prophecy: "Hydrogen cooling is a perfectly practicable thing, and its adoption will mark the next big step forward in the increase in efficiency of these large units." (See "Design Features That Make Large Turbine Generators Possible" by W. J. Foster and M. A. Savage, AIEE Transactions, volume 49, 1930, pages 60–7.)

After making this prediction, we sat back and waited for the orders for hydrogen-cooled machines to pour in, but not one was received. Such are the trials of the prophets. It was not until the advent of the large 3,600-rpm units, in which the windage losses comprise a greater proportion of the total losses, that hydrogen cooling was finally adopted; and in 1935 we actually started to build our first hydrogen-cooled machine.

While the designer receives a great deal of pleasure when his prophecies come true, or when he solves some new problem in engineering, the real thrill and sense of satisfaction come from seeing the completed result of his labors put into service. Thus, I am sure you all appreciate the pleasure it has given all of my associates in the design of large generating apparatus to have so many of these new hydrogen-cooled 3,600-rpm generators go into successful service during the last two years. I believe that these machines mark a notable advance in design, making possible more efficient and dependable service of power supply for the entire country.

The acceptance of a national medal involves certain hazards to the recipient. He is supposed to know something. This on occasion might be embarrassing. I am reminded of some advice given us by one of our old professors at college. He was by reputation quite a wit. Being a firm believer in the old adage that "brevity is the soul of wit," he spoke in a rather terse, clipped manner. On the occasion of our last meeting with him, he gave us this gem: "You boys meet with me for the last time this morning. You are about to be graduated and go out into the world. I suppose you think you know it all—but you don't. My advice to you when you get outside is: Don't talk too much. If you do, they will be certain to find out how little you do know. Class is dismissed." After thirty-three years, I still think that is pretty good advice.



The hydrogen-cooled generator of this modern turbine-generator set was designed under the direction of Mr. Savage

55th Annual Summer Convention Held in San Francisco, Calif.

COMBINED with the annual Pacific Coast convention, the Institute's 55th annual summer convention, held at the Fairmont Hotel, San Francisco, Calif., June 26–30 inclusive, was the second such meeting to be held by the Institute on the Pacific Coast. Upon three other occasions, summer conventions have been held west of Chicago: Salt Lake City, Utah, 1921; Denver, Colo., 1928; Pasadena, Calif., 1936.

As may be noted from accompanying tabulations, the total registered attendance of 940 at San Francisco was well above the long-time average attendance for summer conventions (815 for the period 1920–38, inclusive). Other details pertaining to convention activities may be found on the following pages.

Annual Business Meeting

Returning to the practice of previous years, the Institute's official annual meeting was the first thing on the program, held the morning of the first day of the Convention rather than the second as at Washington last year. The meeting was called to order at 10 o'clock Monday morning, June 26, in the Gold Ballroom of the Fairmont Hotel by General Convention Chairman S. J. Lisberger. Mr. Lisberger successively introduced Past Vice-President P. M. Downing (1925–27) who delivered an address of welcome; H. W. Hitchcock, vice-president-elect; and President John C. Parker, who presided for the business session.

In his remarks of welcome, Mr. Downing, by way of reminding his audience of the contributions to electrical history made by the Pacific Coast, presented the following comments:

"It is especially appropriate that this year's convention of the Institute be held in San Francisco. It so happens that this year marks the 60th anniversary of the establishment of what we believe was the first central electric generating station in the world's history.

"This was the plant of the California Electric Light Company, one of the progenitors of today's Pacific Gas and Electric Company. It began operating in 1879. The equipment of the station was crude and small. It consisted of two Brush generators, one with a capacity of 5 and the other of 16 arc lamps. The original Palace Hotel was one of the first customers.

"While electricity had been generated prior to 1879 in individual factories and other places for lighting purposes, the San Francisco plant appears to have been the first on record to be established for the commercial distribution of electricity to customers at a distance from the generating machines. History gives the honor to the Pearl Street Station of New York, but there seems to be no doubt that two years or more before Pearl Street started operating, electricity was being delivered to arc lights on the premises of customers in San Francisco.

"Electrical developments followed in rapid succession. The record shows the first of all hydroelectric installations was built in San Bernardino in 1887. The first such plant to serve a distant demand was built at Oregon City in 1889 to supply the city of Portland, Ore., thirteen miles away. The first three-phase installation transmitting a distance of 23 miles at 10,000 volts was the Mill Creek Power House No. 1 installation in southern California. The first such installation in northern California went into operation in 1895, when the 3,000-kilowatt Folsom plant began transmitting power at 11,000 volts over a line 22 miles long to Sacramento. That plant is still in operation as a part of the Pacific Gas and Electric Company's system.

"Tribute is due to the entire electrical engineering profession for the achievements of its members on the Pacific Coast, especially in the fields of hydro construction and generation, long-distance high-voltage transmission and rural electrification."

With this as a background, Mr. Downing mentioned the wealth of sight-seeing and technical inspection trips available in and from San Francisco. Mr. Hitchcock amplified Mr. Downing's latter remarks and, on behalf of other visitors, expressed appreciation to the committees responsible for the excellence of the program arranged. President Parker, in taking over the gavel, likewise paid tribute to convention committees.

Reports of the Board of Directors and the Committee of Tellers

In keeping with custom, National Secretary H. H. Henline presented an abstract of the annual report of the board of directors for the fiscal year ending April 30, 1939, emphasizing that the full text of the report was available to every member (published in Electrical Engineering, July 1939, pages 305–17, inclusive; also reprint pamphlets). Among the highlights mentioned by Mr. Henline were the following: That two new sections—San Diego, Calif., and Mansfield, Ohio—were formed during the year, bringing the total to 67; that section meeting activities had expanded for the fifth consecutive year, having run from 521 meetings to 635 in that period of time; that the holding of group meetings, special technical meetings, and other special activities intended to broaden the appeal of section activities likewise had expanded; that of the 120 Student Branches, only one failed to report activities during the past year; that the publication committee with the approval of the board of directors had put into effect a revised publication policy during the year; and that membership during the year increased from 16,078 to 16,605, representing about 90.5 per cent of the maximum peak as against the level of about 78 per cent to which it fell during the depth of the depression.

Section and Branch activities, mentioned only in abstract by Mr. Henline and in the report of the board of directors, are reported in detail in the comprehensive annual report which may be found on pages 268–71 of the June issue of Electrical Engineering. Other items concerning Section and Branch activities have been published throughout the year, as they have become available.

As a traditional part of the annual meeting program, the names of the newly elected officers were read, and President Parker presented to President-Elect Farmer his official badge of office. The text of the report of the committee of tellers was published on page 301 of the July issue. The texts of President Parker's convention address and of Mr. Farmer's initial message as president may be found elsewhere in this issue.

Treasurer's Report

Verifying the record of the Institute's finances, as published by the auditor's statement included in the report of the board of directors, National Treasurer W. I. Slichter, professor of electrical engineering, Columbia University, New York, N. Y., gave a digest reflecting the Institute's financial position. Although income was down slightly for the year ended April 30, expenses were reduced accordingly, thus for the fourth successive year enabling the placing of a nominal amount in the reserve capital account against future possible requirements. Based upon the cost of securities in this fund, Treasurer Slichter reported an average rate of 4.11 per cent income for the year 1938–39. He reported also various changes in investments, with a trend toward high-grade and short-term bonds in the interests of greater security and greater liquidity.

Prize Awards

Chairman H. S. Osborne of the committee on award of Institute prizes read a report covering the awards made for technical papers presented during 1938. This report was published in full on page 271 of the June issue.

AIEE Lamme Medal for 1938 Presented to M. A. Savage

"For able and original work in the development and improvement of mechanical construction and the efficiency of large high-speed turbine alternators," the eleventh AIEE Lamme Gold Medal was presented to Marion A. Savage (A'21), designing engineer, General Electric Company, Schenectady, New York. Ill health prevented the attendance of Mr. Savage. Consequently it was to P. L. Alger of Schenectady, representing Mr. Savage, that President Parker presented the medal and the certificate. Preceding the award presentation, Director D. C. Prince of Philadelphia gave a brief discussion of Benjamin Garver Lamme and the medal, and Past-Vice-President P. M. Downing of San Francisco outlined the career of the medalist. On behalf of the medalist, Mr. Alger read a message from Mr. Savage. The text of the statements by Mr. Downing and Mr. Savage may be found elsewhere in this issue.

Established for the encouragement and recognition of "meritorious achievements in the development of electrical apparatus or machinery," the AIEE Lamme Medal is one of three such bequests provided in 1924 in the will of Benjamin Garver Lamme, former chief engineer of the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., who died July 8, 1924. The bequest provides for the award by the Institute of a gold medal, together with a bronze replica thereof, annually to a member of the AIEE, and for the award of two such medals if in some years the accumulation from the fund warrants such action. A committee composed of nine Institute members makes the award.

Other Lamme Medal Awards

One of the other bequests was made to the Society for the Promotion of Engineering Education, "for accomplishment in technical teaching, or actual advancement of the art of technical training," which award for 1938 (the twelfth) went to Doctor Steven P. Timoshenko, professor of mechanics, Stanford University, California. The third bequest was made to Ohio State University, Columbus, "for meritorious achievement in engineering or the technical arts," which current medal was awarded to Thomas A. Boyd of the General Motors Research Laboratory.

Other Convention Features

With only minor exceptions the technical and general sessions and entertainment features of the convention followed the pattern of the program as previously published in Electrical Engineering. The 41 technical papers, presented during the course of the 9 technical sessions, will be published in volume 59 (1940) of the annual Transactions, and certain of them will be scheduled for reprinting in the Transactions sections of the early 1940 issues of Electrical Engineering. The general session address, "Human Relationships," given by Dr. Adam S. Bennion, assistant to the president of the Utah Power and Light Company, is scheduled for publication in an early issue.

Two informal technical conferences—one on the subject "Teaching of Communication and Electronics," and one on the subject "Sensitive Ground Protection"—were the scenes of active discussions by the two groups interested in these special topics. The sessions were not reported.

The convention meeting of the Institute's board of directors is reported elsewhere in these columns.

Student Activities

Two student technical sessions were held on Wednesday and Thursday afternoons to avoid conflict with other technical sessions:

Wednesday Afternoon, June 28

Presiding, Cecil Carrière, University of California.

Transient Response of Crystal Microphones, **Paul Engelder, California Institute of Technology**

Water-Cooled Radio Frequency Amplifiers with Grounded Anodes, **Opal Cummins** and **Willice E. Groves,** University of Utah

The Construction of Low-Grid-Loss Receiving Tubes, **E. N. Proctor,** Stanford University

Measurements of Galvanic Reactions, **Joseph B. Possner,** University of Southern California

Generation of Square-Wave Voltages at High Frequencies, **W. H. Fenn,** University of California

Thursday Afternoon, June 29

Presiding, M. F. Fraresso, University of British Columbia

Investigation of a Network Relay as an Automatic Synchronizing Device, by Student Branch Chairman, University of Nevada

Compound Frequency Control of Power Systems, **Thomas E. Curtis,** University of California

Transient Stability of Synchronous Machines, **M. H. Yamakawa,** Stanford University

A Survey of the Electric Power System of the Cornucopia Gold Mines, **Louis N. Stone,** Oregon State College

Dynamic Characteristics of D-C Single-Operator Arc Welders, **Joseph S. Mascovich,** University of Santa Clara

A New Design AC-DC Meter, **Keats Pullen,** California Institute of Technology

A Student Branch dinner was held in the Army and Navy clubrooms of the Fairmont Hotel, Wednesday evening, June 28. The 63 persons attending this dinner included student chairmen and counselors of Districts 8 and 9 and the western portion of District 10, and others interested in Student Branch work. Following the dinner meeting, a conference session was held under the chairmanship of Professor W. G. Angermann of the University of Southern California, Los Angeles, chairman of the committee on student activities for District 8. The principal portion of this session was devoted to informal addresses, delivered by President Parker, Vice-President-Elect H. W. Hitchcock, and Chairman R. W. Sorensen of the national committee on Student Branches.

Table I. Analysis of Attendance at 1939 Summer and Pacific Coast Convention, San Francisco, Calif.

Classification	Districts 1	2	3	4	5	6	7	8	9	10	Totals
Members	30	35	32	13	31	7	15	254	54	7	478
Enrolled Students						1		39	16	1	57
Men guests		7	3		11	1	3	34	15	1	75
Women guests	12	28	22	9	27	6	13	155	53	5	330
Totals	42	70	57	22	69	15	31	482	138	14	940

Table II. Summer Convention Attendance During Recent Years

Year	Place		Attendance
1939	San Francisco, Calif.	*(8)	940
1938	Washington, D. C.	(2)	825
1937	Milwaukee, Wis.	(5)	1,067
1936	Pasadena, Calif.	(8)	715
1935	Ithaca, N. Y.	(1)	904
1934	Hot Springs, Va.	(4)	351
1933	Chicago, Ill.	(5)	968
1932	Cleveland, Ohio	(2)	1,022
1931	Asheville, N. C.	(4)	525
1930	Toronto, Ont., Canada	(10)	1,110

* District numbers in parentheses.

Entertainment

The three principal features of the organized entertainment program were the tea for men and women held Monday afternoon in the Mark Hopkins Hotel; the "AIEE Day" at the Golden Gate International Exposition on Treasure Island, which culminated in a convention dinner held at the Yerba Buena Club on the Island, with a heavy overflow accommodated at the nearby Island Club; and the convention banquet with its entertainment and dancing held Thursday evening in the Gold Ballroom of the Fairmont Hotel. Attendance at the various activities, as reported by the committee in charge, was as follows:

	Number Participating
Sight-seeing Tour of San Francisco, Monday afternoon, June 26	225
Women's trip to Stanford University and luncheon at Allied Arts, Thursday, June 29	75
Men's trip to Stanford University and Ryan Laboratory, Thursday afternoon, June 29	100
Men's trip to University of California and Cyclotron, Friday afternoon, June 30	60
Trips to points of interest of the San Francisco-Oakland Bay Bridge Electrification Project	50
Miscellaneous trips to Stations A and C, Marten Station, etc.	50
Informal reception and Tea at Hotel Mark Hopkins, Monday afternoon, June 26	487
Dinner on Treasure Island, Yerba Buena and Island Clubs, Tuesday evening, June 27	500
Banquet at Fairmont Hotel, Thursday evening, June 39	474

Sports Events

With weather conditions ideal for comfortable attendance at the various technical sessions and other meetings, and with the severe competition offered by the Exposition and the many scenic and historical attractions of the city of San Francisco, the several traditional sports competitions suffered rather severely for lack of contestants. Effective work on the part of the

committee, however, kept the competitions open, with the following results:

The Mershon golf trophy, available for national competition among Institute members on the basis of match play and handicap, was won by F. R. George of the San Francisco Section, 1/2 up, with W. G. Stearns of San Francisco as runner-up. Mr. George thus becomes the fourth to have his name engraved upon the present trophy, which is the third cup donated by Past-President Ralph Mershon. This trophy remains on display at Institute headquarters.

The Lee trophy, presented in 1932 by the late Past-President W. S. Lee, is awarded each year to the member having the lowest net score for 36 holes, and must be won twice by the same player for permanent possession. Again the principal competition was between two San Franciscans, W. G. B. Euler (handicap 21) winning with a net 135 from D. D. Smalley (handicap 17) whose net score was 139. Mr. Euler thus became the eighth person to win a leg on the cup and the privilege of having his name engraved thereon.

The John B. Fisken golf trophy, placed in competition in 1920 by the Portland Section and named in honor of John B. Fisken (A'03, F'13) of Spokane, Wash., was won by L. J. Moore of San Francisco, with 66 net (handicap 24) against W. G. B. Euler and his 66 net (handicap 21) by a draw. Competition for the Fisken trophy is on the basis of medal play with handicap, and is limited strictly to active members of Pacific Coast Sections.

Guest competition in the golf tournament was won hands down by Frank J. English of Denver, Colo., with 69 net (no handicap).

Professor L. A. Pipes of Cambridge, Mass., won the men's singles in the tennis tournament (3–6, 6–4, 6–3) and thus became the fifth to have his name engraved upon the present Mershon tennis trophy, which was donated in 1935 by Past-President Mershon; runner-up was A. J. Hoover of Denver, Colorado. Honors in the men's doubles were won by F. J. Groat of New York and F. S. Benson of San Francisco (7–5, 6–3) against J. S. Moulton and his son, James, Jr., of San Francisco. The mixed doubles tournament was won by L. A. Pipes of Cambridge, Massachusetts, and Elinore Bricca of San Francisco (6–4, 6–3) against Mr. and Mrs. F. J. Groat of New York. Women's singles tennis tournament was won by Mrs. F. J. Groat of New York, with Mrs. W. C. Lynch of Los Angeles as runner-up.

Aside from the official trophies, the principal items among the valuable prizes distributed by the local sports committee were in the form of merchandise orders, which gave the winners the opportunity to choose awards to suit their tastes.

Tennis matches were played on the courts of the California Tennis Club, San Francisco. Golf tournaments were played at the Claremont Country Club, Oakland, across the bay from San Francisco.

Annual Conference of Officers, Delegates, and Members, Held at San Francisco, Calif.

Two afternoons, Monday, June 26, and Wednesday, June 28, during the summer convention week in San Francisco were devoted to the sessions of the annual conference of officers, delegates, and members. The conference was held under the joint sponsorship of the AIEE committees on Sections and Student Branches. Attendance at these sessions averaged about 125 and included delegates from 65 of the Institute's 67 Sections, 5 of the 10 District secretaries, counselor delegates from all 9 Districts in which committees on student activities have been organized, and many others interested in this phase of Institute activities. The San Antonio and Mexico Sections were the only ones not represented. With Doctor H. H. Race of Schenectady, chairman of the Sections committee, presiding, the program for these sessions was as follows:

Monday Afternoon, June 26, 2:00 p.m.

Opening remarks—President J. C. Parker

Report on meeting of Sections committee held in New York, January 24, 1939—M. S. Coover

On information to secondary schools—R. W. Sorensen, chairman committee on Student Branches

Short recess to permit Student Branch Counselors to retire to their own meeting.

Section Activities

1. General summary—H. H. Race, chairman Sections committee
2. A "Committee on Young Men" proposed for each Section—Charles F. Scott
3. Potentialities of groups within the Sections—A. L. Powell, chairman New York
4. General discussion of Section activities.

Wednesday Afternoon, June 28, 2:00 p.m.

Changes in assigned territories—H. H. Race, chairman Sections committee

The licensing of professional engineers

1. The Model Law—C. R. Beardsley
2. Experiences with registration problems—Henry D. Dewell, president California State Board of Registrations for Civil Engineers
3. Professional organization of engineers—H. J. Dible, Ohio; I. B. Garthurs, Minnesota; and George Charlesworth, Iowa

Miscellaneous Section problems

At the completion of the first three items on the first session's program, the conference was separated into two groups, the Sections delegates and the Student Branch counselors holding separate sessions.

"Young Men in the Profession"

Ways and means whereby the Institute may serve more effectively the young men of the profession were the subject of appreciable discussion. President Parker, in his brief preliminary remarks, stated that the problem as to what the Institute could do "to make itself more useful to the younger members" was one of the most important that had come to his attention during his presidential year. He pointed out that in some Sections there seemd to be "a very well-developed spirit of making use of the younger men, those in their twenties and early thirties," but that this was "not anywhere near as universal as it should be." In general he urged the Sections to keep the age level of their officers and operating committees down rather than up. He urged that Section and other Institute activities be so arranged as to give the younger members of the profession every possible opportunity to meet with older practicing engineers on grounds of common interest, warning at the same time against any tendency to segregate and isolate the younger members as a class. He urged more effort generally in following the successful lead of certain Sections in "breaking down the age barriers and letting the youngsters feel that this is their Institute and that they have a place in it; that they not only are welcome, but are expected to participate in the activities."

Similarly, Past-President (1902–1903) Charles F. Scott in a written message read by M. S. Coover, concerned himself with the young men of the profession, putting the question, "How can his professional society contribute to his development?" Doctor Scott stated that "'The advancement of theory and of practice' in the future really rests with the young engineers today." He urged that "in each Section a committee of sympathetic, understanding, and alert members join with energetic youth to make a general survey to find the answer." He mentioned as "good but meager" the occasional meetings held by Sections jointly with nearby Student Branches, the various technical and other courses that are being run for the younger engineers by some Sections, and other similar activities. Doctor Scott stated further: "The problem of the young engineer is to be fitting himself for his next and larger job, while concentrating on his present task—it is the challenge of the engineers of today to make better engineers for tomorrow," and urged all Section officers to take the general question seriously to heart. It may be remembered that it was Doctor Scott who, during his term as president, developed the AIEE Student Branch idea and was responsible for broadening the Institute's activities in that and other related directions.

Doctor R. W. Sorensen, chairman of AIEE committee on Student Branches, reported that one of the principal projects of his committee during the past year has been the preparation of new copy for the reissuance of a booklet describing electrical engineering as a profession. The re-issuance of this student guidance booklet was discussed and acted upon favorably at a previous annual conference, and the project subsequently approved by the board of directors. Doctor Sorensen reported that it was the hope of his committee to be able to have the booklet in circulation by the beginning of the forthcoming school year, and that it would serve as the basis for effective counseling and guidance for pre-college students interested in electrical engineering. Further on the subject of student guidance, Doctor Sorensen said that he hoped that engineering educators would be able successfully to impress their engineering students with the fact that they should not wait until graduation to be engineers, but that in effect they are engineers when they embark upon a college engineering course. A student with this thought constantly in mind can "direct his course accordingly, instead of planning for something he is going to do after graduation, because, after all, four of the richest years of any student's life are those four years of undergraduate work."

Many Sections reported that the younger men (say under 35 years of age) conduct most of the work of the Section. One Section has 60 per cent of its membership active in committee work.

The chairman urged each Section membership committee actively to seek contact with all student members who move into its territory each year, and to stimulate transfer to Associate grade and participation in Section committee work.

Some of the Sections are now providing information to secondary-school counselors and students to help the latter decide whether they are fitted for and want to subject themselves to the rigorous training required to enter the electrical-engineering profession. *Whether it be through affiliated local engineering societies or through special committees, each Section was urged to consider this activity one of its most important opportunities for service to future members of our profession.*

Section Activities

Section activities came in for liberal discussion and rather extensive exchange of experiences. Chairman Race initiated the discussion of this subject by distributing to the Section delegates, and subsequently abstracting, an eight-page mimeographed report summarizing the information on Section activities that has been accumulated during the last few years by the Sections committee. The underlying purpose of the report was to place in the hands of each new incoming group of Section officers a brief record of the experience that preceding groups of Section officers had found valuable. Abstracts from this report will appear in a later issue of Electrical Engineering.

Chairman A. L. Powell of the New York Section explained at some length the scope and character of the meetings, educational courses, and other special activities that have been conducted by the New York Section during recent years, and which have been effective in greatly increasing the number of individual members participating in the activities of that Section. Liberal discussion and exchange of experiences and views ensued.

Brief discussion indicated that in general the present assignments of Section territory are satisfactory. In response to inquiries, Chairman Race emphasized the fact that any particular point still requiring attention should be taken up directly with the vice-president for the District by the individual or the Section involved, sending copies of correspondence to the chairman of the Sections committee.

Engineering Registration —Proposed Model Law

Initiating a general discussion of the subject of engineering registration and of the proposed AIEE Model Law, Chairman C. R. Beardsley of the AIEE special committee on Model Law reviewed briefly the circumstances that led to the inception of legal registration for engineers, and outlined the history of the movement. Mr. Beardsley reported in part as follows:

"Forty-two states have licensing laws, and others are considering enactments, varying in scope of application and basic requirements. Recently, through efforts of the National Council of State Boards of Engineering Examiners, there is an approach to uniformity and reciprocity. However, there is a great deal of ground to be covered before complete reciprocity will be obtained.

"There has been some misunderstanding of the relation of AIEE to registration. While the Institute has been represented on joint committees in the preparation of other model laws, it has *never* given endorsement to those model laws because they did not fit electrical-engineering practice. Some publications have listed the Institute as having participated, thereby implying endorsement contrary to fact. The AIEE as a group has not taken a position either for or against licensing as a principle. However, in 1937, following some informal meetings and discussion, the board appointed a committee on Model Law. That committee prepared a statement of principles that may be found in the June 1, 1939, draft of the Model Law. The board unanimously approved this statement of principles. The text of the Model Law, based on these principles, was then drafted and circulated to Sections and others in mimeograph form. At Section meetings, it was requested that discussions be held and comment or criticism sent in. A few Sections have complied, mainly those in states contemplating new legislation. Other institutions and state boards have examined the draft. Generally, comment has been favorable. Only a very few adverse criticisms have been received....

"The essential point in controversy is whether or not *all* engineers should be licensed or whether there should be some exemptions. Those who advocate universal licensing do so with the avowed aim of either (1) arbitrarily restricting the number of persons who may practice engineering, thereby limiting supply and raising compensation, or (2) unifying the profession by regimentation in a body authorized by law as the exclusive group who may practice....

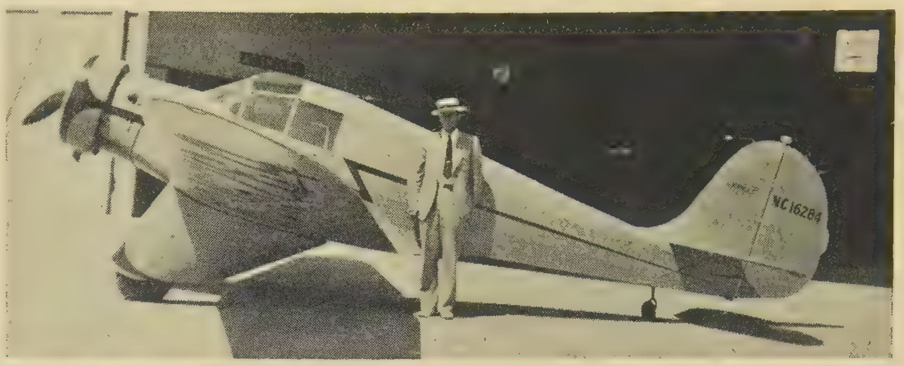
"We have taken the position that licensing laws are enactable only for the purpose of protecting the public, and that their scope should be limited to that objective; that laws designed to advance the profession as a group are not only unethical, but unnecessary....

"The remaining differences between the AIEE Model Law draft and others are all corollary to this main question of scope. There are other problems, such as definition of professional engineering and exemptions, level of minimum competence, method and scope of examination (to allow for specialization in various branches of practice), enforcement, reciprocity, maintenance of high integrity in State Boards, etc....

"The Sections are the logical agencies to study legislation and crystallize the opinion of individuals, and to join with other engineering groups actively to oppose or support legislation according to its merit. We can no longer remain passive and lethargic in a matter so greatly affecting engineering futures.

"The Model Law has been sent to various organizations, as well as to AIEE Sections. Already we have the endorsement of some engineering bodies, but most encouraging is the fact that four of the State Boards have endorsed our proposals. Doctor Charles F. Scott, president of the National Council of State Boards of Engineering Examiners, said it has solved for them some troublesome problems....

Section Delegate Flies Own Airplane to Convention



SHOWN here are E. J. Biegel (A'25, M'31) and his airplane, which he flew to the recent summer and Pacific Coast convention, San Francisco, Calif., as the official delegate from the Institute's Memphis Section. The airplane is a low-wing Aeronca and has a cruising speed of about 110 miles per hour. Mr. Biegel says that he flew from Memphis to San Francisco in about 20 hours. He also flew this airplane to the 1938 Pacific Coast convention, held at Portland, Ore., and to the Southern District meeting in Miami, Fla., the end of November, 1938.

Future AIEE Meetings

Great Lakes District Meeting
Minneapolis, Minn., September 27–29, 1939

Middle Eastern District Meeting
Scranton, Pa., October 11–13, 1939

Winter Convention
New York, N. Y., January 22–26, 1940

Summer Convention
Swampscott, Mass., June 24–28, 1940

Pacific Coast Convention
Vancouver, B. C., August 27–30, 1940

"We hope to have endorsement or constructive criticism to the effect that all engineering societies can agree on a model law; then gradually, through the local Sections, have it enacted on the statutes of the various states."

President Henry D. Dewell of the California State Board of Registration for Civil Engineers described briefly the highlights of California's experience with ten years of partial engineering registration. Chairman A. L. Powell of the New York Section outlined some of the experiences of the New York Section in connection with the New York State Engineering Registration Laws. Experiences incidental to the organization of engineers in the States of Ohio, Minnesota, and Iowa were described, respectively, by H. J. Dible of the Cleveland Section, I. B. Garthus of the Minnesota Section and George Charlesworth, chairman of the Iowa Section. Subsequent general discussion led to a request from Chairman Beardsley of the AIEE Model Law committee and Chairman Race of the Sections committee that *each Section appoint a special committee, not only to give consideration to the proposed AIEE Model Law, but also to keep constantly in touch with matters of legislation likely to affect electrical engineers.*

Change in Prize Paper Rules

A suggestion originating with the executive committee of the Northeastern District, upon which favorable action was taken by the committee on Student Branches in its San Francisco conference session, resulted in the unanimous adoption of a recommendation to the board of directors that the rule governing the award of District prizes for papers be reworded to read as follows (proposed changes appear in italics):

"Only papers presented *subsequent to those considered for the last previous award in the class, and prior to the end of the last* calendar year shall be considered for the prize for Best Paper and for Initial Paper. Only papers presented *subsequent to those considered for the last previous award in the class and prior to the end of the last* academic (college) year, July 1 to June 30, inclusive, shall be considered for the prize for Branch Paper and for Graduate Student Paper. They must be submitted in duplicate by authors, or by officers of the Section, Branch, or District concerned to the District secretary on or before the following dates: Best Paper and Initial Paper—February 15; Branch Paper and Graduate Student Paper—July 15."

The purpose of this proposed change in rules is to enable papers submitted for prize competition to be accumulated for more than the present stipulated one-year period. This point is of especial significance where perhaps only one or two papers become available in any one year.

Counselor-Delegate Session

After a preliminary period of joint session with the Section delegates, the counselor-delegates and others especially interested in the work of the committee on Student Branches withdrew from the general conference Monday afternoon, June 26, to hold a separate session under the direction of Chairman R. W. Sorensen of that committee. Incidental to the discussion of problems and questions of mutual interest, two recommendations were adopted:

1. That the "rules governing the award of Student Branch papers be so amended that each District be permitted to set the closing date for papers from that District to be considered for the District Student Branch paper award."

2. That the "committee on Student Branches be encouraged to give consideration to other than monetary awards for District prize-winning papers."

The substance of the first recommendation subsequently was endorsed by the conference as a whole, which adopted a recommended re-wording for the District prize regulation, as reported in a preceding paragraph. The second recommendation was referred to committee for consideration.

In Memoriam

ARTHUR E. KENNELLY

On the 18th day of June, 1939, a man pre-eminent on the honor roll of the Institute's great passed from our ranks. In the loss of Doctor Arthur E. Kennelly, there was taken from us one of those few of whom it can be truly said neither his word nor his motives were ever questioned. Universally recognized for his ability to solve the most intricate of technical problems, it was, however, through his frequent and unanimous selection as the presiding judge in the bitter debates through which the profession of electrical engineering has come that there was placed upon Dr. Kennelly the real hallmark of his qualities as a man.

Born in 1861, Doctor Kennelly received his education in the schools of Europe and America. At the age of fourteen, he became assistant secretary of what is now the Institution of Electrical Engineers. Employed in his early days in the telegraph field, he became in 1887 the principal assistant to Thomas A. Edison. Later he was consultant for the Edison General Electric and the General Electric Company. In 1902, he was appointed professor of electrical engineering at Harvard, becoming professor emeritus at that University and the Massachusetts Institute of Technology in 1930. A prolific writer, Doctor Kennelly's best known contribution probably is his explanation of the mechanism of the transmission of radio waves.

The recipient of degrees and honors both here and abroad, Doctor Kennelly was named Honorary President of the International Electrotechnical Commission. He was a member of many of the most important of our Institute committees and served as manager, vice-president, and finally president for the terms 1898 to 1900. In 1933, he was elected an Honorary Member and in the same year was awarded the Edison Medal.

With this brief outline of the accomplishments of Doctor Arthur E. Kennelly, it is with the keenest appreciation of the many parts he has ably played in the life of the Institute and the profession that the board of directors hereby expresses its deep sorrow at his death, and resolves that this minute be spread on the Institute records.

—AIEE Board of Directors, June 29, 1939

Board of Directors Approves Model Registration Law

In view of the endorsements and many favorable comments received, the AIEE board of directors at its meeting in San Francisco, Thursday, June 29, 1939, voted unanimous approval of the June 1, 1939 draft of the AIEE Model Law, proposed for governing the licensing of engineers. A communication from Chairman C. R. Beardsley of the special AIEE committee on Model Law, addressed to all the AIEE Sections, supplements the general discussion that took place on the subject at the annual conference of officers, delegates, and members, held during the summer convention in San Francisco and reported elsewhere in these columns. Mr. Beardsley pointed out that in October 1938 the Institute's board of directors had authorized the issuance and preliminary distribution of this draft as tentative and for the purpose of obtaining comments that would have a bearing upon modification or adoption of the draft. Generally favorable comment has been received from both within and without the membership of the Institute, including favorable comments from several State Boards of engineering registration.

As to the possible applications of the Model Law, Chairman Beardsley pointed out that the "Sections are, of course, autonomous as to their consideration of local problems, and the national body and officers are estopped from intervention in such matters. It hardly needs the suggestion that Section action should not be such as to involve the national body by the inference that it—rather than the Section—is the author of any local action or statement." Mr. Beardsley urged that all Sections that have not already done so should appoint committees on legislation, so as to keep continuously in touch with matters of local and State legislation likely to affect the status of electrical engineers,

pointing out that members of Sections may wish to oppose or support amendments according to their judgment of the merit of individual proposals. It is emphasized that such laws may have a far-reaching effect on engineering practice and progress, and that engineers cannot afford to be passive and unwary. Such committees may well compare any proposed amendments with the AIEE Model Law, which has received a preponderance of endorsement as being well suited to the control of the practice of electrical engineering.

Chairman Beardsley emphasized the fact that the June 1 draft of the Model Law is considered neither perfect nor final; that the special committee and the board are anxious to give attention to any suggestions for possible improvement that may arise incidental to local conditions that may be encountered by any Section. He asserted that, with licensing laws now existing in forty-two States, and probably soon to exist in the remaining States, "all considerations should look toward complete reciprocity." As evidence of the importance of this point, Chairman Beardsley cited the case of the chief engineer of a large holding company who was obliged to undergo the routine of application and examination in several States in order to conduct his work therein.

The committee on Model Law is cited as standing ready to analyze and advise in any way in which any Section may desire assistance. Inquiries or comments may be addressed either to National Secretary H. H. Henline or to Chairman C. R. Beardsley of the AIEE special committee on Model Law, 4 Irving Place, New York, N. Y.

Three Districts Announce Prize Awards for Papers

District prizes for AIEE papers have been announced by three Districts to date. Other District prizes will be announced later as the information becomes available. The awards are for papers presented during 1938, except Branch papers, which must have been presented during the academic year ending June 30, 1938, according to the revised rules adopted in 1937.

District 1

Prize for best paper was awarded to C. W. LaPierre and A. P. Mansfield for their paper "Photoelectric Weft-Straightener Control," presented at the North Eastern District meeting, Lenox, Mass., May 18, 1938.

Prize for Branch paper was awarded jointly to Edward G. Schroeder for his paper "Investigation of Heat Dissipation and Temperature Rises in Underground Ducts" and to P. P. Koliss and Joseph Ezen for their paper "Analysis of an Electron-Tube-Controlled Induction Motor," presented at the North Eastern District meeting, Lenox, Mass., May 20, 1938.

District 2

Prize for Branch paper was awarded to Joseph M. Rodgers for his paper "An Automatic Frequency Regulator for D-C Motor-Driven Alternators," presented at a joint meeting of the Cincinnati Section and University of Cincinnati Branch, May 12, 1938.

District 9

Prize for best paper was awarded to Edgar C. Goodale for his paper "A Graphical Method of Multiplying and Dividing Complex Quantities, and Its Use in the Solution of Impedance Networks," presented at a meeting of the Seattle Section, March 22, 1938.

AIEE Directors Meet During Summer Convention

The regular meeting of the board of directors of the American Institute of Electrical Engineers was held at the Fairmont Hotel, San Francisco, Calif., June 29, 1939, during the annual summer convention of the Institute.

Present: *President*—John C. Parker, New York, N. Y. *Past President*—A. M. MacCutcheon, Cleveland, Ohio. *Vice-Presidents*—F. C. Bolton, College Station, Tex.; C. L. Dawes, Cambridge, Mass.; F. M. Farmer, New York, N. Y.; L. R. Gamble, Spokane, Wash.; J. P. Jollyman, San Francisco, Calif.; I. M. Stein, Philadelphia, Pa.; E. D. Wood, Louisville, Ky. *Directors*—C. R. Beardsley, H. S. Osborne, New York, N. Y.; W. B. Kouwenhoven, Baltimore, Md.; F. H. Lane, L. R. Mapes, Chicago, Ill.; K. B. McEachron, Pittsfield, Mass.; C. A. Powel, East Pittsburgh, Pa.; D. C. Prince, Philadelphia, Pa.; R. W. Sorensen, Pasadena, Calif. *National Treasurer*—W. I. Slichter, New York, N. Y. *National Secretary*—H. H. Henline, New York, N. Y. Present by invitation: Vice-President-Elect H. W. Hitchcock, Los Angeles, Calif.

Minutes of the meeting of the board of directors held May 26, 1939, were approved.

The board adopted a resolution in memory of Doctor Arthur E. Kennelly, past-president, Edison Medalist, and Honorary Member of the Institute, who died on June 18, 1939. (See preceding page.)

A report was presented and approved of a meeting of the board of examiners held on June 15, 1939. Upon the recommendation of the board of examiners, the following actions were taken: 4 applicants were transferred to the grade of Fellow; 22 applicants were transferred and 10 were elected to the grade of Member; 120 applicants were elected to the grade of Associate; 46 Students were enrolled.

The finance committee reported expenditures in June amounting to $22,952.04, and the report was approved.

Dates of August 27–30, recommended by the local officers concerned, were approved for the 1940 Pacific Coast convention to be held in Vancouver, B. C.

Upon request of the Baltimore Section and recommendation of the Sections committee, the board authorized a change in name of that Section to "Maryland Section."

Having been elected to the presidency of the Institute for the year beginning August 1, 1939, F. Malcolm Farmer tendered his resignation as vice-president, representing the New York City District, as of July 31, 1939. His resignation was accepted by the board.

Upon nomination of the executive committee of the New York City District, the board elected T. F. Barton vice-president of the Institute, New York City District (number 3) for the unexpired term, ending July 31, 1940, of Mr. Farmer.

The resignation of Gano Dunn as a representative of the Institute on the Hoover Medal Board of Award was accepted, and Past-President A. W. Berresford was appointed for Doctor Dunn's unexpired term, ending in May 1945.

The board voted unanimously to approve the June 1, 1939, AIEE Draft of Model Law for Registration of Professional Engineers and Land Surveyors, which had been prepared by a special committee of the Institute and discussed at this and previous meetings of the board of directors, distributed to the Sections of the AIEE, and discussed at the conference of officers, delegates, and members held June 28, 1939.

R. W. Sorensen was appointed a delegate of the Institute to attend the annual meeting of the National Council of State Boards of Engineering Examiners, July 26–29, 1939, in San Francisco, Calif.

The board adopted resolutions expressing appreciation of the effective services of the 1939 combined summer and Pacific Coast convention committee and its subcommittees, and of the women's entertainment committee.

The meeting adjourned after an expression by President Parker of his appreciation of the co-operation given him by the members of the board during his term as president, followed by a rising vote of thanks to President Parker for his faithful and effective administration.

Other matters were discussed, reference to which may be found in this or future issues of Electrical Engineering.

Executive Committee of Southern District Meets

During the recent AIEE combined summer and Pacific Coast convention at San Francisco, Calif., a luncheon meeting of delegates from the Institute's Southern District (4) was held June 28. Those present were:

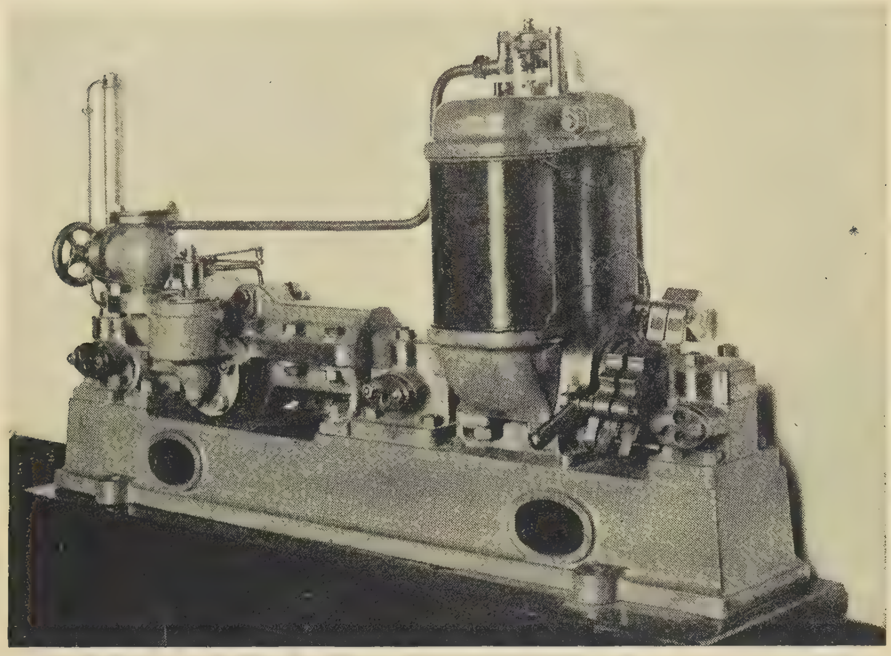
E. D. Wood, vice-president, Southern District
L. L. Patterson, District student counselor delegate
R. S. Fouraker, North Carolina Section
F. R Maxwell, Jr., Alabama Section
J. M. Flanigen, Georgia Section
E. J. Biegel, Memphis Section
F. E. Bell, Muscle Shoals Section
L. L. Newman, New Orleans Section
J. F. Houseley, East Tennessee Section
E. F. Smith, Florida Section
A. S. Hoefflin, district secretary, Louisville Section

Following approval of the minutes of the last meeting of the committee, Vice-President Wood, who presided, expressed his gratification that delegates from all Sections in the Southern District were present at the convention and that all were present at this meeting, except one—J. A. Rawls of the Virginia Section.

Mr. Flanigen reported that the Georgia Section is proposing that the 1941 AIEE summer convention be held in Atlanta, and urged all Section representatives to back the proposal in every way possible. It was understood that if the invitation is accepted by the national board of directors, no meeting will be held by the District prior to that time.

The question of whether or not Institute Section meetings should be open to the

Early Parsons Steam Turbine at New York Fair



AN engineering relic of unusual historical interest is the Parsons reaction-type turbogenerator unit, built in 1885, now on exhibition in the Hall of Metals of the British Government Pavilion at the New York World's Fair. The reaction-type steam turbine was originated by Charles A. Parsons, and the first units were built in 1884 and 1885 at the shops of Messrs. Clark, Chapman, Parsons, and Company, Gates Head Works, England. Only two are known to exist today, the first ever made, which is at South Kensington Museum, London, and the one now at the World's Fair, which was the fifth to be built. It is the property of the Allis-Chalmers Manufacturing Company, Milwaukee, Wis., having been presented to the company in 1912 by Mr. Parsons himself. The unit, shown in the accompanying illustration, operated at 18,000 rpm and was rated ten effective horsepower. It is a noncondensing steam turbine direct-coupled to a Parsons d-c dynamo. The unit is 12 inches wide, with an over-all length of 5 feet; the dynamo is $14^1/_2$ inches wide.

public or confined to engineers was raised by Mr. Bell of the Muscle Shoals Section. The ensuing discussion seemed to indicate that the general practice is to invite anyone interested to the technical meetings, but that occasionally recreational or social meetings are held to which only members and their families are invited.

The meeting was adjourned at 1:50 p.m. so that the delegates could return to the second session of the annual conference of officers, delegates and members.

Executives to Serve ASA as Advisory Body

Thirteen prominent executives, representing manufacturing, finance, retailing, and education, will serve as an advisory committee for the American Standards Association, according to recent announcement. Reorganization of the advisory committee to its present form is indicative of the growing recognition of the importance of standardization as a managerial function. The ASA was organized in 1918 by five of the engineering societies, the AIEE having taken the first steps toward its formation. It was then called the American Engineering Standards Committee. Trade associations and the Federal Government were next brought into its work, and later the organization was given its present name and structure, with responsibility for policy centering in a board of directors of industrial executives. Its work has since been extended increasingly to problems which affect management and merchandising: safety, prevention of occupational diseases, traffic regulations, building codes, and, most recent, standards for consumer goods.

The committee, which brings major executives into the national standardization program as the final source of advice, has the following members:

Howard Coonley, chairman of board, Walworth Company, New York, N. Y., *chairman;* Ralph Budd, president, Chicago, Burlington and Quincy Railroad, Chicago, Ill.; F. L. Carlisle, chairman of board, Consolidated Edison Company of New York, N. Y.; Doctor Karl T. Compton (F'31) president, Massachusetts Institute of Technology, Cambridge, Mass.; Lammot du Pont, president, E. I. du Pont de Nemours and Company, Wilmington, Del.; Lincoln Filene, president, William Filene's Sons Company, Boston, Mass.; W. S. Gifford (A'16) president, American Telephone and Telegraph Company, New York, N. Y.; L. A. Lincoln, president, Metropolitan Life Insurance Company, New York, N. Y.; J. H. McGraw, Jr., president, McGraw-Hill Publishing Company, New York, N. Y.; A. W. Robertson (A'27) chairman of board, Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa., and New York, N. Y.; A. P. Sloan, Jr., chairman of board, General Motors Company, New York, N. Y.; E. R. Stettinius, chairman of board, United States Steel Corporation, New York, N. Y.; W. C. Teagle, chairman of board, Standard Oil Company of New Jersey, New York, N. Y.

Tentative Program for District Meeting at Scranton

For the AIEE Middle Eastern District meeting, to be held in Scranton, Pa., October 11–13, 1939, the tentative technical program consists of sessions on mining, rating of electrical machinery and apparatus, power transmission and distribution, meters, relays and protection, and electrical apparatus. In the session on rating of electrical machinery and apparatus, P. L. Alger, chairman of standards co-ordinating committee 4 will give a résumé of the work of the standards committee in revising AIEE Standard No. 1. Arrangements also are being made for a meeting of co-ordinating committee 4 to be held on Wednesday morning, October 12. In addition to the technical program there will be inspection trips, reception and entertainment, informal dinner-dance, and other social events and trips for women guests.

Members of the District meeting committee are: I. Melville Stein, H. A. Dambly, E. F. DeTurk, W. A. Furst, E. E. Kimberly, J. W. Mills, H. S. Phelps, J. E. Treweek E. F. Weaver.

AIEE Baltimore Section Becomes Maryland Section

Upon recommendation of the AIEE Sections committee, the board of directors at its meeting June 29, 1939, authorized a change of name of the Baltimore Section to the Maryland Section. No change in Section territory is involved. The Section includes Baltimore, Frederick, Carroll, Cecil, Harford, Howard, Anne Arundel, Kent, Queen Anne's Talbot, Caroline, Dorchester, and Wicomico counties in Maryland; Kent and Sussex counties in Delaware; and York, Lancaster, and Adam counties in Pennsylvania.

The Baltimore Section was organized December 16, 1904. The new officers of the Maryland Section for the term 1939–40 are: *chairman*, H. A. Frey (A'28) electrical engineer, Locke Insulator Corporation, Baltimore; secretary, G. R. Page (A'30) engineer, Point Breeze Works, Western Electric Company, Baltimore.

Great Lakes District Meeting and Branch Convention

Minneapolis will be host to a three-day meeting and Student Branch convention of the Great Lakes District, AIEE September 27–29, 1939. Hotel Nicollet will be meeting headquarters.

Tentative arrangements are being made for a program of five technical sessions, two student sessions, inspection trips, entertainment, and sports. The detailed program will be announced later.

The city of Minneapolis with its modern and convenient transportation facilities provides an ideal location for the meeting. Sight-seeing by visitors may include the flour mills located on the Mississippi River at St. Anthony Falls, the University of Minnesota, the Minneapolis Symphony Orchestra, the Minneapolis boulevard and park systems, historic Fort Snelling, the "Twin City" of St. Paul, Lake Minnetonka, Minnehaha Falls.

ACS Will Celebrate Goodyear Centenary. A special program in honor of the hundredth anniversary of Charles Goodyear's discovery of vulcanization of rubber will feature the 98th meeting of the American Chemical Society, to be held in Boston, Mass., September 11–15. Doctor Karl T. Compton (F'31) president of Massachusetts Institute of Technology, will be one of the speakers on the centenary program. A symposium on vulcanization will also be part of the technical program of the meeting, which will cover progress in all major spheres of chemical science.

Future Meetings of Other Societies

American Chemical Society. Fall meeting, September 10–15, Boston, Mass.

American Institute of Physics. Temperature symposium, November 2–4, New York, N. Y.

American Society of Civil Engineers. International fall meeting, September 4–9, New York, N. Y.

American Society of Mechanical Engineers. Fall meeting, September 4–8, New York, N. Y.

Joint meeting ASME Fuels Division, AIME Coal Division, October 5–7, Columbus, Ohio.

Association of Iron and Steel Engineers. Annual convention, September 26–29, Pittsburgh, Pa.

Conference on Electrical Insulation (National Research Council). November, Cambridge, Mass.

Electrochemical Society. Fall convention, September 11–13, New York, N. Y.

Illuminating Engineering Society. 33d annual convention, August 21–25, San Francisco, Calif.

Institute of Radio Engineers. 14th annual convention, September 20–23, New York, N. Y.

Fall meeting, November 13–15, Rochester, N. Y.

National Electrical Contractors Association. October 9–12, Philadelphia, Pa.

National Electrical Manufacturers Association. October 23–27, Chicago, Ill.

National Safety Council. October 16–20, Atlantic City, N. J.

Société Française des Électriciens. Television meeting, November, Paris, France.

Society of Automotive Engineers. National aircraft production meeting, October 5–7, Los Angeles, Calif.

Electrical Insulation Conference to Meet

The Conference on Electrical Insulation, sponsored by the division of engineering and industrial research of the National Research Council, will hold its next annual meeting early in November 1939 at Cambridge, Mass., Chairman J. B. Whitehead has announced. The exact dates will be announced later. Members of the Conference will be guests of Harvard University.

Members have been asked to furnish information about research now under way, upon which reports may be made in the technical program of the meeting. This may be research by members and their associates, or any other research or activity concerned with electrical insulation that may be of interest to the meeting. Both finished papers and informal progress reports will be included in the program.

Lightning Generator at New York Fair

Use of new materials and improved design, resulting in reduced size for increased capacity, gives additional interest to the modern 10,000,000-volt artificial-lightning generator being used in public demonstrations by the General Electric Company in Steinmetz Hall at the New York World's Fair. Two units of cylindrical capacitors, piled in six vertical stacks 34 feet high, occupy less than one-fourth the floor space required for the square metal containers used in former lightning generators, but have 40 per cent greater capacity. The stored energy of the new generator is 165,000 watt-seconds. It takes only 15 seconds for the voltage to reach full value

before discharging across a 30-foot gap, as compared with 150 seconds for the earlier unit. Looking up at one bank of capacitors, the accompanying illustration shows the Herkolite cylinders interposed between units for insulation. The insulators are painted black and all exposed metal parts are stainless steel. As the current is short circuited when all capacitors are fully charged, flashovers occur between small spheres projecting from rods in the center.

N. C. Club Celebrates Anniversary. The Engineers Club of Western North Carolina, organized May 16, 1938, reported on its first anniversary an increase from 43 to 70 members, successful professional and social activities, and a sound financial position. The club was established as a professional organization in which all branches of engineering are represented. C. E. Waddell (A'02, F'12) consulting engineer, Asheville, N. C., is a member of the board of directors.

Current Items From American Engineering Council

Changes in Patent System Before Congress

A series of bills proposing simplification and speeding up of the procedure by which patents are issued by the Patent Office have been introduced in Congress. These bills embody suggestions made by Commissioner of Patents Conway P. Coe in testimony before the Temporary National Economic Committee and are supported, in general, by the patent bar. Since very little opposition has been voiced, it is hoped to pass at least some of the bills before Congress adjourns.

The principal changes proposed are:

1. Reclassification of Patent Office records by a force of 25 additional examiners whose entire time shall be devoted to this task. Modernization of the classification system, now admittedly antiquated and confusing, is expected to expedite the examination of future patent applications and thus conserve the time of both examiner and applicant. (H.R.6721.)

2. Reduction in the time allowed for public use of an invention before applying for a patent from two years to one year. (H.R.6872.)

3. Simplification of the present interference practice, which decides which of two conflicting applications shall be granted, by referring the matter to a three-man board of interference examiners and issuing a patent immediately in consonance with their decision. Thereafter the losing party can, if he wishes, appeal the matter, but the present long delay in issuance whenever such appeal is taken is eliminated. (H.R.6873.)

4. Reduction of the time for paying the final patent fee from six to three months after notice that the application has been approved. The Commissioner is given discretion to extend this time an additional year if justification for the delay is demonstrated. (H.R.6874.)

5. Limitation of the time for copying claims into an application from prior patents to those

issued within one year, rather than two. (H.R.-6875.)

6. Reduction in the allowed time for responding to Patent Office communications from the present six months to not less than 30 days, at the discretion of the Commissioner. (H.R.6878.)

7. Termination of the life of a patent at 17 years after date of issue or 20 years after date of application, whichever is shorter. (S.2688.)

8. Setting up a single Court of Patent Appeals to which shall be referred all appeals from decisions of United States District Courts regarding patent cases. (S.2687.)

Bills noted in items 1 to 6, inclusive, were passed by the House on July 6; those in items 7 and 8 were approved by the Senate Patents Committee on July 6.

Utility Study Issued

A statistical study of the operations of 385 privately owned electric utility companies, comprising about nine-tenths of the industry, for the calendar year 1937 has been published in two volumes by the Federal Power Commission and is available at $2 per set.

Covering companies with annual revenues of $250,000 or more, the report reveals total electric revenues of $2,157,277,266 from the operation of total assets valued at $16,873,-384,102. Outstanding securities total $13,-378,579,835, of which bonds and other long-term obligations account for $6,850,194,447; preferred stocks $2,125,431,564; common stocks $4,306,363,835.

Residential customers during the year averaged 19,627,633 in number, and paid $645,748,799 for 14,821,890,000 kilowatt-hours of power, an average of 755 kilowatt-hours per year per customer at an average cost of 4.3 cents. Commercial and industrial sales accounted for 65,202,088,000 kilowatt-hours of consumption, $1,105,092,-543 of revenue, an average price of 1.7 cents.

The Commission is also preparing to publish a national electric rate book showing the residential, commercial, and industrial electric rates charged by all utility companies in the United States, whether privately or publicly owned. This material will be bound in a loose-leaf binder so that subsequent revisions can easily be substituted to keep the volume up to date. The price will be $15, including any supplements that may be issued up to December 31, 1939; subsequent supplements will cost $7.50 per year. Separate issues covering individual states will also be available at from $1 to $2 each, depending on size.

John Carmody Appointed Public Works Head

On July 1 general supervision of public works activities of the federal government was vested in John M. Carmody, engineer and former head of the Rural Electrification Administration, who was named by President Roosevelt Administrator of the Federal Works Administration, created under the terms of the Reorganization Act. The position carries a salary of $12,000, one of the highest outside the cabinet and the Supreme Court, and is expected to become one of the most important posts in the Federal establishment.

An avowed liberal, Mr. Carmody left a position as labor relations executive with the Davis Coal and Coke Company to become editor of *Coal Age* and also *Factory and Industrial Management*. In 1933 he was appointed chairman of the Bituminous Coal Labor Board, and later became chief engineer for the Civil Works Administration and its successor, the Federal Emergency Relief Administration. He subsequently served as a member of the National Mediation Board and the National Labor Relations Board, resigning to head the Rural Electrification Administration in 1936. He is a past president of the Society of Industrial Engineers and a member of the Taylor Society and the American Association for Labor Legislation.

Appointed to head the second new agency under the Reorganization Act, the Federal Loan Agency, was Chairman Jesse Jones of the Reconstruction Finance Corporation.

Letters to the Editor

CONTRIBUTIONS to these columns are invited from Institute members and subscribers. They should be concise and may deal with technical papers, articles published in previous issues, or other subjects of some general interest and professional importance. ELECTRICAL ENGINEERING will endeavor to publish as many letters as possible, but of necessity reserves the right to publish them in whole or in part, or reject them entirely.

ALL letters submitted for consideration should be the original typewritten copy, double spaced. Any illustrations submitted should be in duplicate, one copy to be an inked drawing but without lettering, and the other to be lettered. Captions should be furnished for all illustrations.

STATEMENTS in these letters are expressly understood to be made by the writers; publication here in no wise constitutes endorsement or recognition by the American Institute of Electrical Engineers.

A D-C Application of Hyperbolic Functions

To the Editor:

Three problems in two-wire d-c distribution have always interested the writer. The solution in every case consists in obtaining the voltages and currents everywhere along the line.

Problem 1: Two or more loads kw_1 and kw_2 are distant l_1 and l_2 from a generator at voltage E_G. The student meets this problem for the first time in his elementary course in direct currents. It can be solved by a fourth-degree equation in E_1 or E_2, also by a fourth-degree equation in I_1 or I_2. If there are three loads, the solution involves a sixth-degree equation, and so on. These equations can be solved most quickly by the cut-and-try method.

Problem 2: A line has a constant resistance per foot of r ohms; it has a uniformly distributed load per foot of i amperes. This line has a uniformly increasing current toward the generator, also a cumulatively increasing voltage toward the generator. By using a small differential strip dx and integrating throughout the length of the line L, a solution is easily obtained; viz., voltage drop on line is equal to $^1/_2 RI$, where $R = 2Lr$ is the resistance of the line, and $I = iL$ is the current at the generator. In this particular case the line is open at the load.

Problem 3: A line has a uniform resistance and a uniformly distributed load of constant conductance (or resistance). In this case the current increase from load toward generating station is a graph of hyperbolic sines (not uniform as in the second case) while the voltage increase from load toward generating station is a graph

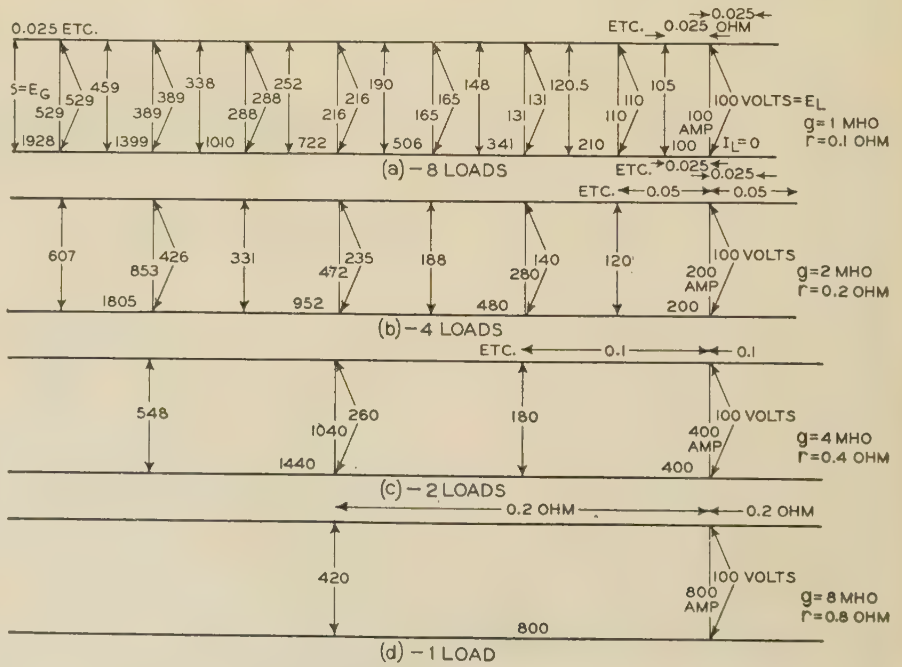


Figure 1. The true voltage and current distribution along the line

of hyperbolic cosines (not cumulatively increasing as in the second case). This is the very practical case of the d-c or a-c network; also, to a lesser degree, the residential lighting circuit.

The purpose of this discussion is to solve problem 3 by using the hyperbolic functions; also to show how accurate they become when there are eight loads, four loads, two loads, and one load.

The theory needed is as follows:

$$E_G = E_L \cosh\theta + I_L Z_0 \sinh\theta \text{ vector volts}^2 \quad (1)$$

$$I_G = I_L \cosh\theta + E_L/Z_0 \sinh\theta \text{ vector amperes} \quad (2)$$

where E_G and I_G equal voltage and current respectively at generator end of line, and E_L and I_L equal voltage and current respectively at load end of line The line is considered to be open at the load (see figure 1), in which case $I_L = 0$ and hence equation 1 becomes

$$E_G = E_L \cosh\theta \quad (1a)$$

and equation 2 becomes

$$I_G = E_L/Z_0 \sinh\theta \quad (2a)$$

Let

g = conductance of each load in mhos *per load* (corresponds to leakage conductance in transmission);

and

r = resistance of line in ohms *per load*.

Now

$\alpha = \sqrt{gr}$, vector numeric, expressed in real hyperbolic radians *per load*.

And

$\theta = \alpha l$, vector numeric, where l is the number of loads (length of line in transmission).

$Z_0 = \sqrt{r/g}$, vector ohms.

α is called the attenuation constant of line *and load* (line in transmission).

Z_0 is called the characteristic *resistance* of the line (characteristic impedance in transmission).

The true data as calculated for a specific problem is given: for an eight-load case in figure 1*a;* for a four-load case in figure 1*b;* for a two-load case in figure 1*c;* and for a one-load case in figure 1*d*.

The use of equations 1*a* and 2*a* will give an accurate result for an infinite number of loads only.

In table I, *a*, column 7, E_G is given, figure 1 (i.e., 625 for the eight-load case) and E_L is calculated ($I_L = 0$), column 8.

In column 9, E_L is given, figure 1 (i.e., 100 for each case) and E_G and I_G are calculated at each load, columns 10 and 12.

Comments on Table and Figures

Column 2, $\alpha = \sqrt{gr} = \sqrt{1 \times 0.1} = 0.316$ for part I*a*, table I; $\alpha = \sqrt{2 \times 0.2} = 0.632$ for part I*b;* etc., see figure 1.

Column 3, $\theta = \alpha l = 8 \times 0.316 = 2.53$.

Column 4, $Z_0 = \sqrt{r/g} = \sqrt{0.1/1} = 0.316$ for part I*a;* $Z_0 = \sqrt{0.2/2} = 0.316$ for part I*b;* etc.

Columns 8 and 9 show how the hyperbolic solution, $E_L = 99+$, compares with the true solution, $E_L = 100$. Per cent error $= 1-$.

Columns 10 and 11 show how the hyperbolic solution, $E_G = 632$, compares with the true solution, $E_G = 625$. Per cent error $= 1-$.

Columns 12 and 13 show how the hyperbolic solution, $I_G = 1{,}970$, compares with the true solution, $I_G = 1{,}928$. Per cent error $= 2+$.

Broken curve 1, figure 2, is E_G true, obtained from figure 1*a* at each load for the eight-loads case, column 11.

Smooth curve 2, figure 2, is E_G calculated, by the hyperbolic solution at each load, column 10.

Broken curve 3, figure 2 is I_G, true, obtained from figure 1*a* at each load for the eight-loads case, column 13.

Smooth curve 4, figure 2, is I_G calculated, by the hyperbolic solution at each load, column 12.

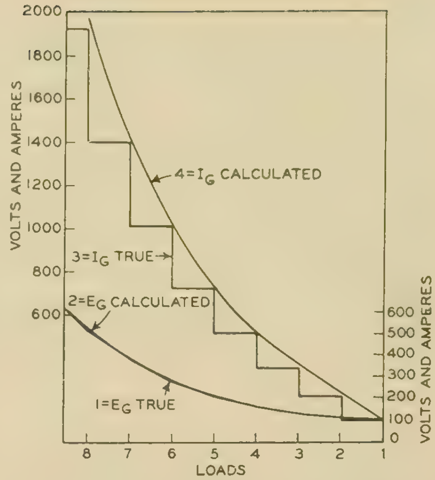


Figure 2. Voltage and current distribution along the line, both true and calculated by the hyperbolic method

Curves 1 and 2 practically coincide; curves 3 and 4 practically coincide at each load. All calculations were made with slide rule; no interpolation was used in getting $\cosh\theta$ and $\sinh\theta$.

Conclusions

1. The hyperbolic solution may be used for eight loads or more than eight with very little error in E_L, when E_G is known; table I, part I*a*, column 8.

2. The hyperbolic solution may be used for voltage and current distribution along the line for eight loads or more than eight with very little error in E_G and I_G, when E_L is known; curves 1, 2, 3, 4, figure 2.

3. When loads greater than eight in number are to be dealt with, this method, using hyperbolic functions, saves much time over a longhand method, figure 1, and gives sufficiently accurate results; this is especially true when practical values of g and r are used. The values $g = 1$ mho, $r = 0.1$ ohm, were chosen to simplify calculations. Practical values of g and r for the eight or more load case would make the hyperbolic method almost imperative.

4. The hyperbolic solution can be applied to the calculation of currents in a network, voltages along the network, lowest voltage in a network, voltage regulation, and so on.

5. It can be used just as readily on an Edison three-wire system as on a two-wire system.

6. It can be used for a-c circuits in low-voltage distribution; the charging current in this case is negligible and the actual load currents replace the leakage current.

References

1. Application of Hyperbolic Functions to Electrical Engineering, A. E. Kennelly. McGraw-Hill Book Company, New York, 1925. Third edition, page 12.

2. Principles of Electric Power Transmission and Distribution, L. F. Woodruff. John Wiley and Sons, Inc., New York, 1925. First edition, page 132.

Very truly yours,

J. L. Beaver (A'14, F'26)

(Professor of electrical engineering, Lehigh University, Bethlehem, Pa.)

Table I

	Part I. Given E_G, to calculate E_L ($I_L = 0$)							Part II. Given E_L ($I_L = 0$), to calculate E_G, I_G				
1	2	3	4	5	6	7	8	9	10	11	12	13
Loads	α	$\theta(=\alpha l)$	Z_0	$\cosh\theta$	$\sinh\theta$	True E_G (Fig. 1)	Calculated E_L ($= E_G/\cosh\theta$)	True E_L (Fig. 1)	Calculated E_G ($= E_L \cosh\theta$)	True E_G (Fig. 1)	Calculated I_G ($= E_L/Z_0 \sinh\theta$)	True I_G (Fig. 1)
(*a*) Eight loads on line												
at 8th	0.316	2.53	0.316	6.32	6.24	625	99+	100	632	625	1,970	1,928
at 7th	0.316	2.21	0.316	4.61	4.50	459	99+	100	461	459	1,420	1,399
at 6th	0.316	1.90	0.316	3.42	3.27	338	99+	100	342	338	1,034	1,010
at 5th	0.316	1.58	0.316	2.53	2.32	252	99+	100	253	252	733	722
at 4th	0.316	1.26	0.316	1.91	1.62	190	99+	100	191	190	512	500
at 3d	0.316	0.95	0.316	1.49	1.10	148	100−	100	149	148	347	341
at 2d	0.316	0.63	0.316	1.21	0.676	120.5	100−	100	121	120.5	214	210
at 1st	0.316	0.316	0.316	1.05+	0.321	105	100−	100	105	105	102	100
(*b*) Four loads on line												
at 4th	0.632	2.53	0 316	6.32	6.24	607	96	100	632	607	1,970	1,805
at 3d	0.632	1.90	0 316	3.42	3.27	331	97	100	342	331	1,034	952
at 2d	0.632	1.26	0.316	1.91	1.62	188	99	100	191	188	512	480
at 1st	0.632	0.63	0.316	1.21	0.676	120	100−	100	121	120	214	200
(*c*) Two loads on line												
at 2d	1.265	2.53	0.316	6.32	6.24	548	87	100	632	548	1,970	1,440
at 1st	1.265	1.26	0.316	1.91	1.62	180	95	100	191	180	512	400
(*d*) One load on line												
at 1st	2.53	2.53	0.316	6.32	6.24	420	66	100	632	420	1,970	800

Personal Items

T. F. Barton (A'12, F'30) assistant manager of the New York district, General Electric Company, New York, N. Y., has been elected a vice-president of the AIEE, representing District number 3, New York City. Mr. Barton was born December 25, 1885, at Orangeburg, S. C., and studied electrical and mechanical engineering at Clemson Agricultural College, where he received the degree of bachelor of science. In 1906 he entered the testing department of General Electric Company, at Schenectady, N. Y., and in 1909 was transferred to the d-c engineering department. He served in the engineering department of the company's New York office from 1911 to 1917, when he returned to Schenectady as a section head in the central-station-engineering department. He became district engineer of the New York district in 1927, and in 1939 was appointed to his present position. Mr. Barton has twice won Charles A. Coffin Foundation awards for contributions to the electrical industry. He was chairman of the AIEE New York Section in 1932–33, chairman of the 1939 winter convention committee, and is a member of the committees on economic status of the engineer and on legislation affecting the engineering profession.

M. E. Leeds (A'01, F'26) founder and president of the Leeds and Northrup Company, Philadelphia, Pa., has become chairman of the board of directors in an expansion of the company's executive organization. Born in Philadelphia March 6, 1869, Doctor Leeds received the degree of bachelor of science from Haverford College in 1888, studied at the University of Berlin in 1892–93, and received the honorary degree of doctor of engineering from Brooklyn Polytechnic Institute in 1936. After two years of teaching, Doctor Leeds entered the scientific-instrument business in 1890 with Queen and Company, Philadelphia, remaining with the company until 1899. In that year he organized and became managing partner of Morris E. Leeds and Company, which in 1903 became the Leeds and Northrup Company, with Mr. Leeds as president. He holds numerous patents on electrical measuring instruments and associated equipment and in 1920 was awarded the Edward Longstreth medal of the Franklin Institute, Philadelphia, of which he is a member. He received the Gant Medal of the Institute of Management in 1936. He is also a member of the American Association for the Advancement of Science, the American Physical Society, American Society for Steel Testing, American Society for Testing Materials, academy of Natural Sciences, and Phi Beta Kappa.

R. P. Brown (A'10, M'13) has been appointed the first secretary of the new Department of Commerce of the Commonwealth of Pennsylvania. He is chairman of the board of the Brown Instrument Company, Philadelphia, Pa. Born in Philadelphia September 26, 1884, he studied at Drexel Institute, and in 1904 was employed by Edward Brown, manufacturer of thermoelectric pyrometers. In 1906 he became a member of the firm of Edward Brown and Son. The firm became the Brown Instrument Company in 1910 with Mr. Brown as its president, a position he held until recently. He is also vice-president and director of the Minneapolis-Honeywell Regulator Company, an associated firm. He holds the patents for various electrical instruments, and is a member of The American Society of Mechanical Engineers, American Society for Testing Materials, and the Franklin Institute, Philadelphia.

A. M. Dudley (A'08, F'13) engineering representative in the patent department, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., has been awarded the honorary degree of doctor of engineering by the University of Michigan. Doctor Dudley has received the degrees of bachelor of science in engineering (1902) and electrical engineer (1931) from the University of Michigan, and master of science (1933) from the University of Pittsburgh. He has been with the Westinghouse company since 1904, in various engineering positions. He has taught in the Westinghouse design and engineering schools and is a Westinghouse lecturer in electrical engineering at the University of Pittsburgh, Pittsburgh, Pa. He assisted with the accrediting program of the Engineers Council for Professional Development, and was for three years a member of the national council of the Society for the Promotion of Engineering Education.

H. L. Andrews (A'16, M'26) vice-president of General Electric Company, has been placed in charge of the company's appliance and merchandise department, with headquarters in Bridgeport, Conn. A native (1889) of Boonville, Mo., he received the degree of bachelor of science in electrical engineering from the University of Missouri in 1910, and entered the testing department of General Electric at Schenectady, N. Y. He has been with the company continuously, becoming assistant engineer in 1925, chief engineer, transportation engineering department, 1929, and from 1934 until his present appointment was vice-president in charge of transportation activities. He has been vice-chairman of the company's sales committee for three years.

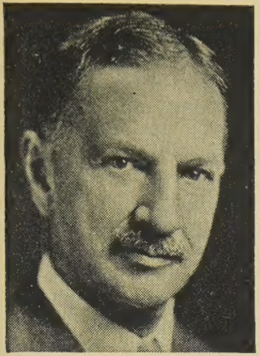
C. S. Redding (A'12) has been made president of Leeds and Northrup Company, Philadelphia, Pa. Born in Philadelphia in 1883, Mr. Redding received the degree of bachelor of science in electrical engineering from the University of Pennsylvania in 1906. Before entering college he spent a year in the laboratory of Morris E. Leeds and Company, Philadelphia, predecessor of Leeds and Northrup, and in 1909, after two years as an instructor in mechanical engineering at the University of Pennsylvania, Philadelphia, he returned to Leeds and Northrup. He has since held executive positions in every division of the company's activities, as sales manager, factory manager, second vice-president (1918) treasurer (1922–24), and vice-president in charge of research and engineering from 1928 to the present. He is a member of the American Physical Society, American Association for the Advancement of Science, and the Franklin Institute.

D. W. McLenegan (A'24, M'31) has been made manager of engineering sales in the air-conditioning department of the General Electric Company, in the new divisional organization set up after the consolidation of the company's air-conditioning and commercial-refrigeration activities at Bloomfield, N. J. Mr. McLenegan received the degree of bachelor of science in mechanical engineering from the University of Wisconsin, Madison, and after two years spent teaching engineering mathematics at that institution he entered the research laboratories of General Electric at Schenectady, N. Y., in 1922. He was transferred to the industrial-engineering department the following year, and in 1938 was made manager of the company's air-conditioning institute at Bloomfield, N. J.

H. B. Gear (A'01, F'20), vice-president in charge of operating and engineering, Commonwealth Edison Company, Chicago, Ill., has been awarded the honorary degree of doctor of laws by Marietta College. Doctor Gear received the degree of bachelor of arts from Marietta College in 1892 and the degree of mechanical engineer from Cornell University in 1895. He entered the service of the Chicago Edison Company, predecessor of Commonwealth Edison, in 1895 as electrical inspector, becoming chief inspector, engineer of distribution for Commonwealth Edison, and in 1935 vice-president. He was a director of the AIEE, 1934–38, and is a member of the Edison Medal committee and the commission on the Washington Award.

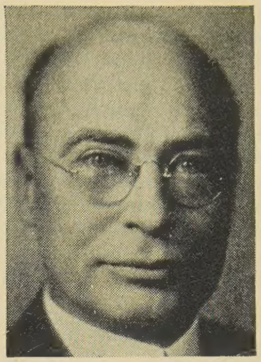
J. E. Lawson (A'22) vice-president and general manager of the Canadian Niagara Power Company, Ltd., Niagara Falls, Ont. Can., has been elected president of the Canadian Electrical Association. Mr. Lawson was born in Clinton, N. Y., in 1881, and began his association with the electrical industry as a helper with General Electric Company in 1903. During the next four years he was with the Canadian Niagara Power Company and Canadian General Electric Company, as well as General Electric. In 1907 he became an electrical fitter for Canadian Niagara Power Company and has remained with the company ever since, as foreman, chief operator, superintendent, and vice-president.

D. M. Simmons (A'22, F'28) chief engineer, General Cable Corporation, New York, N. Y., has been awarded the honorary degree of doctor of engineering by Princeton University. Doctor Simmons received the degrees of bachelor of arts (1911) and electrical engineer (1913) from Princeton. He was with the Standard Underground Cable



M. E. LEEDS

H. L. ANDREWS



C. S. REDDING

T. F. BARTON

R. P. BROWN

Company from 1913 to 1927, when it joined with other companies to form the General Cable Company. In 1928 he was made director of high-voltage engineering in the latter company and in 1930 chief consulting engineer. He is a member of the AIEE committee on power transmission and distribution and of the publication committee.

E. C. Goodale (A'27) has been awarded AIEE District number 9 prize for best paper, for the paper "A Graphical Method of Multiplying and Dividing Complex Quantities, and Its Use in the Solution of Impedance Networks," presented at a meeting of the Seattle (Wash.) Section, March 22, 1938. Mr. Goodale, who is an inspector for the Puget Sound Power and Light Company, Olympia, Wash., studied engineering at Cornell University and has been employed in various engineering capacities by the Syracuse (N. Y.) Lighting Company, Southern California Edison Company, and others, before going with the Puget Sound company in 1926.

W. H. Harrison (A'20, F'31) recently received the honorary degree of doctor of laws from Notre Dame University. Doctor Harrison, who is vice-president and chief engineer of the American Telephone and Telegraph Company, has been with various companies of the Bell System since 1909. He was graduated from Pratt Institute in 1915 in industrial electrical engineering. AIEE past-president (1937–38), he has a long record of active service in the Institute, and is at present a director, Institute representative on the American Engineering Council, and member of several committees.

C. W. LaPierre (A'28) was awarded AIEE District number 1 prize for best paper, jointly with co-author A. P. Mansfield, for the paper "Photoelectric Weft-Straightener Control" presented at the North Eastern District meeting, Lenox, Mass., May 18, 1938. Mr. LaPierre, who studied engineering at the University of Missouri, has been with General Electric Company, in Schenectady, N. Y., and Philadelphia, Pa., since 1923. He is at present an electrical engineer at the company's Schenectady plant.

E. W. Seeger (A'16, F'36) has been appointed manager of the development department, Cutler-Hammer, Inc., Milwaukee, Wis. Mr. Seeger has been with the company continuously since his graduation from Ohio State University in 1913, and prior to this appointment was in charge of the production engineering department. A biographical sketch of him appeared in the February issue, page 91.

C. P. Cooper (A'08, M'21) vice-president, American Telephone and Telegraph Company, New York, N. Y., has been awarded the honorary degree of doctor of science by Ohio State University. Doctor Cooper was graduated from that institution in 1907 with the degree of mechanical engineer in electrical engineering, and was an instructor for a year at New Hampshire State College, Durham, before becoming a plant engineer for the New York Telephone Company. He has been associated with the Bell System ever since, assuming his present position in 1926.

P. P. Koliss (Enrolled Student), with co-author Joseph Ezen, shared in AIEE District number 1 prize for Branch paper, for the paper "Analysis of an Electron-Tube-Controlled Induction Motor," presented at the North Eastern District meeting, Lenox, Mass., May 20, 1938. Mr. Koliss, who received the degree of bachelor of science at Worcester Polytechnic Institute in 1939, is doing graduate study leading to the degree of master of science at that institution.

W. S. Gifford (A'16), president of the American Telephone and Telegraph Company, New York, N. Y., has been appointed a member of the American Standards Association's newly organized advisory committee of executives. Doctor Gifford was also recently made honorary chancellor of Union College for 1939–40, and awarded the honorary degree of doctor of civil law by that institution.

P. B. Harwood (M'36) has been appointed manager of the engineering department, Cutler-Hammer, Inc., Milwaukee, Wis. Mr. Harwood has been with the Cutler-Hammer company since 1917 and prior to his present appointment was assistant in charge of the production engineering department. A biographical sketch of him appeared in the February issue, page 92.

G. T. Shoemaker (M'20), president, the United Light and Power Service Company, Chicago, Ill., has been nominated a manager of The American Society of Mechanical Engineers for 1940. Mr. Shoemaker is also vice-president and general manager of the United Light and Power Company and of several of its subsidiaries. A biographical sketch of him appeared in the October 1938 issue, page 435.

Francis Hodgkinson (A'02) has been nominated a vice-president of The American Society of Mechanical Engineers for the 1940 term. Mr. Hodgkinson, who is a consulting mechanical engineer in New York, N. Y., was awarded the Holley Medal of the ASME in 1938. A biographical sketch of him appeared in the December 1938 issue, page 522.

J. D. Mortimer (A'00) has been elected a director of Associated Gas and Electric Company, New York, N. Y. Mr. Mortimer, formerly president and later director of the North American Company, New York, has had a long career in the public utility industry. A biographical sketch of him appeared in the January issue, page 52.

David Sarnoff (M'23) has been awarded the honorary degree of doctor of science by Suffolk University. Doctor Sarnoff, president of the Radio Corporation of America, has been connected with radio in various capacities since 1906. He studied engineering at Pratt Institute. He is a member of the Institute of Radio Engineers.

R. J. Greer (A'36) has been employed as a junior hydraulic engineer by the Water Resources Branch of the United States Geological Survey, Boston, Mass. He was formerly an inspector on water construction at the Cape Cod Canal, Buzzards Bay, Mass., for the United States Engineering Department.

A. W. Robertson (A'27) chairman of the board, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., has been appointed a member of the advisory committee of executives, recently organized by the American Standards Association.

F. T. McNamara (A'39), assistant professor of electrical engineering, Yale University, New Haven, Conn., has been appointed AIEE representative on the sectional committee on radio-electrical co-ordination—C65, operating under American Standards Association procedure.

K. T. Compton (F'31), president, Massachusetts Institute of Technology, Cambridge, Mass., has been appointed a member of the newly organized advisory committee of the American Standards Association.

W. E. Keith (A'25) has been appointed assistant to the vice-president, personnel department, New England Telephone and Telegraph Company, Boston, Mass. He has been with the company since 1923, and prior to this appointment was unit manager in Boston.

W. H. Sammis (A'20, M'38) has been elected chairman of the Modern Kitchen Bureau of the Edison Electric Institute for 1940. He is vice-president of the Commonwealth and Southern Corporation, New York, N. Y.

H. C. Hamilton (A'23, M'26) has been elected treasurer of the Engineering Societies of New England, Inc., for the year beginning June 1, 1939. Mr. Hamilton is head of the laboratory, Boston Edison Company, Boston, Mass.

Frank Walsh (A'26, M'30) has been elected Washington State vice-president of the Northwest Electric Light and Power Association. Mr. Walsh is division manager, Puget Sound Light and Power Company, Bellingham, Wash.

F. S. Himebrook (A'32) formerly electrical engineer with the General Industries Company, Elyria, Ohio, is now electrical engineer with the Master Electric Company, Dayton, Ohio,with which he has previously been associated.

G. R. Canning (A'32) has been elected president of the Cleveland (Ohio) Engineering Society for the coming year. He is transmission engineer, Ohio Bell Telephone Company, Cleveland.

H. L. Wilcox (M'37) has been elected treasurer of the Cleveland (Ohio) Engineering Society for 1939–40. He is assistant chief engineer, Electric Controller and Manufacturing Company, Cleveland, Ohio.

O. B. Coldwell (A'03, F'12) has been elected Oregon State vice-president of the Northwest Electric Light and Power Association. He is vice-president of the Portland (Ore.) Electric Power Company.

Obituary

Arthur Edwin Kennelly (A'88, M'99, F'13, HM'33) professor emeritus of electrical engineering at Harvard University and Massachusetts Institute of Technology, died in Boston, Mass., June 18, 1939, after a long illness. (The notice which appeared in the July issue incorrectly stated the date of Doctor Kennelly's death as April 18, 1939.) He was born near Bombay, India, December 17, 1861, and received his early education in schools in England, Scotland, France, and Belgium. He was awarded the honorary degree of doctor of science by the University of Pittsburgh in 1895, and by the University of Toulouse, France, in 1922, and received the honorary degree of master of arts from Harvard University in 1906. In 1875 he became assistant secretary of what is now The Institution of Electrical Engineers of Great Britain, and during the next twelve years was an operator for the Eastern Telegraph Company, assistant electrician in Malta, chief electrician of a cable-repairing steamer, and senior ship electrician on submarine cables. He came to the United States in 1887 and was engaged by Thomas A. Edison as principal electrical assistant. He was also consulting electrician for the General Electric Company. In 1894 he became associated with Edwin J. Houston in the firm of Houston and Kennelly. He was appointed professor of electrical engineering at Harvard University in 1902 and continued in that position until 1930. From 1913 to 1924 he was also professor of electrical engineering at Massachusetts Institute of Technology and was for some years director of electrical-engineering research and chairman of the faculty. During 1921–22 he represented seven co-operating American universities as first exchange professor in engineering and applied science at several French universities. Author and co-author of more than a score of books and over 300 technical papers, among his best-known contributions are the first application of complex numbers to Ohm's law in a-c engineering, in a paper presented before the AIEE in 1893, and the theory of the influence of solar ionization in the atmosphere on long-distance radio transmission, presented in 1902, which caused the so-called ionized layer, since verified experimentally, to be named the Kennelly-Heaviside layer. Active in AIEE affairs for 50 years, he had been a vice-president, a manager, president from 1898 to 1900, member of many committees, and AIEE representative on many organizations. He was the first chairman of the Institute's first standardization committee, and continued to be actively engaged both in the work of the AIEE for standardization and in international standardization of electrical units, representing the AIEE at many international conferences in the United States and other countries. He was also past-president of the Illuminating Engineering Society, Institute of Radio Engineers, American Metric Society; member of the American Association for the Advancement of Science, American Academy of Arts and Sciences, American Mathematical Society, and many others; and honorary member of the electrical-engineering societies of Great Britain, France, Germany, and Japan. In 1938 he was made honorary president of the International Electrotechnical Commission. His awards included the Institution Premium and Fahie Premium of The Institution of Electrical Engineers, Great Britain; Longstreth and Howard Potts medals, Franklin Institute; the cross of a Chevalier of the French Legion of Honor; the Mascart Medal of the Société Française des Électriciens, and the Edison Medal of the AIEE.

Julian Cleveland Smith (A'03, M'08, F'12) president, Shawinigan Water and Power Company, Montreal, Que., Can., died June 24, 1939. Born October 7, 1878, at Elmira, N. Y., he received the degree of mechanical engineer in electrical engineering from Cornell University in 1900. He was later awarded the honorary degree of doctor of laws by Queen's University, and by McGill University. After working as a draftsman for the West Manufacturing Company, Buffalo, N. Y., and in the electrial department of the Pan-American Exposition at Buffalo, he became in 1901 assistant to Wallace C. Johnson, consulting engineer, Niagara Falls, N. Y., and in 1902 went to Shawinigan Falls, Que., in charge of installation of high-voltage apparatus. He was made superintendent of the Shawinigan Water and Power Company in charge of the Shawinigan Falls power station in 1903, and four years later became general superintendent of that company and the allied companies of the system. He was subsequently chief engineer, vice-president, and general manager, and since 1933 had been president of the company. He was also president of Quebec Power Company, and vice-president of the Dominion Engineering Works, Ltd., and Dominion Bridge Company. He was a member of The Institution of Electrical Engineers of Great Britain, the American Society of Civil Engineers, and past-president of the Engineering Institute of Canada.

George Frederick Steele (A'10, M'27) died in Boston, Mass., June 25, 1939. A pioneer in the electrical industry, Mr. Steele was associated with the General Electric Company and its predecessors from 1885 until his retirement in 1931. Born in Derry, N. H., October 12, 1863, he was graduated in electrical engineering from Massachusetts Institute of Technology in 1885. He then entered the post-graduate course at the Thomson-Houston Company, Lynn, Mass., and the following year became superintendent of the New England Electric Company, agents of the Sprague Electric Railway and Motor Company. He continued with the New England Electric Company, becoming treasurer and then president, until 1890, when the parent company and the Edison Company consolidated to form the Edison General Electric Company. He was in charge of power work, railway, and lighting, in the Boston office of that organization until it consolidated with the Thomson-Houston company in 1892 to form the present General Electric Company. From 1892 to 1909 he was sales engineer in the Boston office of General Electric, and from 1909 to 1926 district manager of the power and mining department which became the industrial department. He retired from active work in 1926 but continued as a consulting engineer on special sales problems until 1931.

William Orlando Jacobi (A'10, M'30), electrical engineer, Omaha and Council Bluffs Street Railway Company, Omaha, Nebr., died April 10, 1939. He was born June 23, 1886, at Ludington, Mich., and graduated from Lewis Institute in 1909 with the degree of mechanical engineer. During the next two years he was engaged in electrical design and construction for the Pullman Company, Pullman, Ill., and as a draftsman for Stone and Webster in Minneapolis, Minn. In 1911 he was employed by the Omaha and Council Bluffs Street Railway Company on design and construction of power house and substations, later engaging in electrolysis test work. He became superintendent of electric lines and electrical engineer for the company in 1919, and was made secretary of the Omaha and Council Bluffs electrolysis committee in charge of testing.

Grove Cleland Carnahan (A'20), engineer and chief electrician, Illinois Publishing and Printing Company, Chicago, Ill., died April 15, 1939. Born in Apollo, Pa., October 18, 1884, and educated there, Mr. Carnahan began his connection with the electrical industry on construction work for the General Electric Company. After two years as construction foreman for C. G. Rush and Company, Chicago, Ill., he was employed in 1910 by the W. A. Jackson Company, Chicago, and three years later was made constructing foreman on central- and substation work, having charge of various projects in Illinois and Pennsylvania. He later became general foreman of construction for the company. In recent years he had been chief electrician for the Chicago Evening American, and The Chicago Herald and Examiner, before becoming engineer and chief electrician for the Illinois Publishing and Printing Company.

Roy Blake Bryant (A'09), proprietor, Bryant Light and Power Company, Dallas, Tex., died May 21, 1939. He was born in Nashville, Ark., February 14, 1887, and studied electrical engineering at the University of Arkansas. He was then employed as switchboard man by the Little Rock (Ark.) Railway and Electric Company, and later devoted some time to invention of street railway appliances. He was superintendent of the Eldorado Light and Power Company, manager of the Ashdown Light and Power Company, both in Arkansas, and with the DeKalb, Tex., Light and Power Company, of which he became proprietor after the World War. During the War he served in the United States Army, attaining the rank of captain. He subsequently became owner and manager of the Bryant Light and Power Company, Crandall, Tex., and later carried on that business in Dallas.

Spottswood Carmichael Foster (A'11), chief engineer, Bedford Pulp and Paper Company, Big Island, Va., died April 22, 1939. He was born April 23, 1886, in Fredericksburg, Va., and educated there, studying electrical engineering by correspondence. He was employed by the Rappahannock Electric Light and Power Company, Fredericksburg, in 1904 and later became superintendent. After the World War he was for a time a consulting engineer in Fredericksburg, and then became mechanical and electrical engineer for the Bedford Pulp and Paper Company, Colemans Falls, Va. He had been chief engineer for about three years.

J. N. Bourath (A'21), electrical engineer, Electro Dynamic Works of the Electric Boat Company, Bayonne, N. J., died May 13, 1939. Born in Belgium in May 1882, he graduated as an electrical engineer from the Electrotechnical Institute of the University of Liége. He was employed for a short time as draftsman by the Bell Telephone Company in Antwerp, Belgium. In 1911 he became associated with the Electro Dynamic Company, Bayonne, N. J., testing and inspecting electrical machinery, and later designed d-c motors and generators. He continued with the company and its successor until his death, at which time he was in charge of d-c engineering.

Giacomo Merizzi (A'12), director, Tecnomasio Italiano Brown Boveri, Milan, Italy, died recently, according to information received at Institute headquarters. He was born in Italy, January 6, 1866, and studied at the University and Polytechnical School of Turin. From 1898 to 1904 he was electrical engineer with Brown Boveri and Company. He became manager of Tecnomasio Italiano Brown Boveri in 1904, and had been director for more than ten years.

Toda Komaru (A'20), electrical designing engineer, Mitsubishi Electric Manufacturing Company, Ltd., Kobe, Japan, died March 14, 1939, according to information recently received. He was born May 1, 1893, in Kanazawa, Japan, and in 1917 was graduated in electrical engineering from the technical college of Tokyo Imperial University. Following graduation he entered the testing department of the Mitsubishi company as assistant electrical engineer, and the following year was transferred to the design office.

Frederick Milton Servos (A'19, M'27) chief electrical engineer, Rio de Janeiro Tramway, Light, and Power Company, Ltd., Rio de Janeiro, Brazil, died July 8, 1939, in St. Mary's Hospital, Brooklyn, N. Y. Mr. Servos was AIEE local honorary secretary for Brazil. A complete obituary notice will appear in the September issue.

Membership

Recommended For Transfer

The board of examiners, at its meeting on July 20, 1939, recommended the following members for transfer to the grade of membership indicated. Any objection to these transfers should be filed at once with the national secretary.

To Grade of Fellow

Leonard T. Blaisdell, commercial vice-president, General Electric Company, Dallas, Tex.
Charles D. Brown, electrical engineer, Wisconsin Electric Company, Milwaukee.
Robert E. Doherty, president, Carnegie Institute of Technology, Pittsburgh, Pa.
Harry R. Fritz, general plant extension engineer, Southwestern Bell Telephone Company, St. Louis, Mo.
Earle S. Henningsen, engineer, General Electric Company, Schenectady, N. Y.
Terrence O. Kennedy, vice-president and general manager, Ohio Public Service Company, Cleveland, Ohio.
Clarence W. Kuhn, supervising engineer, Cutler-Hammer, Inc., Milwaukee, Wis.
Alexander C. Lanier, professor of electrical engineering, University of Missouri, Columbia.
James F. Lincoln, president, The Lincoln Electric Company, Cleveland, Ohio.
Humphreys Milliken, chief engineer and general superintendent, Montreal Light, Heat and Power Cons., Montreal, Canada.
Chester W. Rice, consulting engineer, General Electric Company, Schenectady, N. Y.
Martin Schiff, chief engineer, Century Electric Company, St. Louis, Mo.
Warner M. Skiff, retired, Palo Alto, Calif.
George E. Snider, electrical engineer, Ohio Public Service Company, Cleveland, Ohio.
H. R. Summerhayes, manager engineering division, central station department, General Electric Company, Schenectady, N. Y.
Robert Treat, engineer, General Electric Company, Schenectady, N. Y.
Herman L. VanValkenburg, vice-president and chief engineer, Square D Company, Milwaukee, Wis.
Wm. E. Wickenden, president, Case School of Applied Science, Cleveland, Ohio.

18 to Grade of Fellow

To Grade of Member

E. W. Allen, plant extension engineer, Southwestern Bell Telephone Company, Oklahoma City, Okla.
Carl E. Arvidson, engineer, Commonwealth and Southern Corporation, Jackson, Mich.
David K. Blake, electrical engineer, General Electric Company, Schenectady, N. Y.
Karl A. Blind, electrical engineer, Harnischfeger Corporation, Milwaukee, Wis.
Fay B. Bramhall, engineer in charge of transmission laboratory, Western Union Telegraph Company, New York, N. Y.
Ralph L. Chantrill, engineer, Associated Electrical Industries (India) Ltd., Calcutta, India.
John Brown Cook, executive vice-president, Reliable Electric Company, Chicago, Ill.
John D. Harnden, assistant to manager, General Electric Company, Schenectady, N. Y.
Obed C. Haycock, assistant professor of electrical engineering, University of Utah, Salt Lake City.
Henry F. Herbig, research engineer, The North Electric Manufacturing Company, Galion, Ohio.
Luke F. Kennedy, relay application engineer, General Electric Company, Schenectady, N. Y.
Walter A. Kilbury, system operator, Cleveland Electric Illuminating Company, Ashtabula, Ohio.
Hector John MacLeod, head, department of electrical and mechanical engineering, The University of British Columbia, Vancouver, B. C., Canada.
Donald E. Moat, district manager, Leeds and Northrup Company, Cleveland, Ohio.
Maxwell L. Olsen, outside plant engineer, Southwestern Bell Telephone Company, Oklahoma City, Okla.
Arthur F. W. Richards, consulting engineer, Richards and Bright, London, W.C.1, England.
Marion A. Savage, designing engineer, General Electric Company, Schenectady, N. Y.
Raymond F. Schierland, assistant engineer, Columbia Engineering Corporation, Cincinnati, Ohio.
Joseph K. H. Sticher, research engineer, The Detroit Edison Company, Detroit, Mich.
Daniel C. Vaughan, system protection engineer, Potomac Electric Power Company, Washington, D. C.
Stewart H. White, superintendent of utilities, City of Port Angeles, Wash.
John W. Wilson, assistant professor of electrical engineering, University of Florida, Gainesville.
Harry A. Winne, engineering, general department, General Electric Company, Schenectady, N. Y.
Richard B. Wright, engineer inspector, Consolidated Edison Company of N. Y., Inc., New York, N. Y.

24 to Grade of Member

Applications for Election

Applications have been received at headquarters from the following candidates for election to membership in the Institute. Names of applicants in the United States and Canada are arranged by geographical Districts. If the applicant has applied for direct admission to a grade higher than Associate, the grade follows immediately after the name. Any member objecting to the election of any of these candidates should so inform the national secretary before August 31, 1939, or October 31, 1939, if the applicant resides outside of the United States or Canada:

United States and Canada

1. North Eastern

Brewer, N. M., Central New York Power Corporation, Utica, N. Y.
Parsons, R. J. (Member), Consolidated Car Heating Company, Albany, N. Y.
Stewart, C. J., Great Lakes Portland Cement Corporation, Buffalo, N. Y.

2. Middle Eastern

Caldwell, G. A., Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa.
Liwschitz, M. (Member), Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.

Pfeifer, A. A., North Electric Manufacturing Company, Galion, Ohio.

3. New York City

Eastman, H. L. (Member), Electric Advisers, Inc., New York, N. Y.
Fenton, A., Consolidated Edison Company of N. Y., Inc., New York, N. Y.
Palmer, A. P., 410 West 207 Street Corporation, New York, N. Y.

4. Southern

Heymann, A. P., 9 North Hyer Street, Orlando, Fla.
Trawick, H. P. (Member), Tallapoosa River Electric Membership Corporation, Lafayette, Ala.

5. Great Lakes

Egan, V. J., Commonwealth and Southern Corporation, Jackson, Mich.
Gaines, B., Fisher Body Company, Detroit, Mich.,
Kallander, O. H. (Member), Care F. S. Haberly Consulting Engineer, Chicago, Ill.
Lyman, P. F., Commonwealth and Southern Corporation, Jackson, Mich.
Willey, R. E., Northwestern Bell Telephone Company, Minneapolis, Minn.

7. South West

Dunlap, L. B., Southwestern Bell Telephone Company, Dallas, Tex.

8. Pacific

Herz, S. V., 3317 Jackson Street, San Francisco, Calif.
Massey, J. T., Pacific Gas and Electric Company, San Francisco, Calif.
Nelson, M. R., General Cable Corporation, Los Angeles, Calif.
ReQua, F. L. (Member), City of San Francisco, San Francisco, Calif.

Total, United States—21

Elsewhere

Erskine, A., The Fife Electric Power Company, East Port, Dunfermline, Fife, Scotland.
Hollander, J. M. (Member), Electro-Mechanical Supplies, Ltd., Coventry, England.
Rush, J. P., Taikoo Sugar Refining Company, Hongkong, China.
Srikantaiya, D. S., Government of Mysore, Hole-Narsipur, Mysore State, India.
Starbuck, L. W. G. (Member), Walker Sons and Company, Ltd., Colombo, Ceylon.

Total, elsewhere—5

Engineering Literature

New Books in the Societies Library

Electrical engineers may be interested in the following new books, which are among those recently received at the Engineering Societies Library, New York, N. Y. Unless otherwise specified, books listed have been presented by the publishers. The Institute assumes no responsibility for statements made in the following summaries, information for which is taken from the preface of the book in question.

THE ECONOMICS OF BUSINESS ENTERPRISE. By W. Rautenstrauch. New York, John Wiley and Sons, 1939. 445 pages, diagrams, etc., 9 by 6 inches, cloth, $4.00. Aims to describe what is generally considered good practice in dealing with the economic problems of specific business enterprises, to inquire into the theories on which these practices rest; and to develop methods of analysis for the economic problems of a particular business. The final chapter treats in general of business enterprise on a national scale.

AIR CONDITIONING. By B. H. Jennings and S. R. Lewis. Scranton, Pa., International Textbook Company, 1939. 467 pages, illustrated, 9 by 6 inches, flexible, $4.00. The fundamentals of air conditioning are so presented as to form a working basis for the engineering student or the practicing engineer. The emphasis is on basic principles, although conventional methods of empirical treatment are given in some cases. Ordinary heating methods and refrigeration are considered at some length. Contains illustrative examples, problems, charts, and tables of data.

APPLIED ACOUSTICS. By H. F. Olson and F. Massa. Second edition. Philadelphia, Pa., P. Blakiston's Son and Company, 1939. 494 pages, illustrated, 9 by 6 inches, leather, $5.50. Presents information on the design, construction, operation, and analysis of modern microphones, loud speakers, and telephone receivers, emphasizing the theoretical and experimental aspects of electro-acoustics. Acoustical measurements, testing methods, architectural acoustics, measurement of noise, and physiological acoustics are also considered.

VDI-JAHRBUCH 1939. Die Chronik der Technik. Edited by A. Leitner. Berlin, VDI-Verlag, 1939. 298 pages, 8 by 6 inches, paper, 3.50 rm. Contains over ninety reports by specialists, reviewing the literature on engineering published during 1938. About 10,000 references on all branches of engineering are included, with an extensive index.

ARC WELDING IN DESIGN, MANUFACTURE AND CONSTRUCTION. Cleveland, Ohio, James F. Lincoln Arc Welding Foundation, care of Lincoln Electric Company, 1939. 1408 pages, illustrated, 9 by 6 inches, leather, $1.50 in U.S.A.; $2.00 in other countries. A selection of 109 of the more than 400 papers which received awards from the James F. Lincoln Arc Welding Foundation, chosen from 44 sub-classifications. Some abridged. Subject index.

THE ELECTRIC POWER INDUSTRY: DEVELOPMENT, ORGANIZATION, AND PUBLIC POLICIES. By J. Bauer and N. Gold, with the technical co-operation of A. E. Shaw. New York and London, Harper and Brothers, 1939. 347 pages, tables, 10 by 6 inches, cloth, $3.50. A non-technical presentation of the public aspects of the industry for engineers, economists, and the general reader. Discusses the development and importance of the electric power industry, private organization and management, and problems of public policy and control. Selected bibliography.

AIR CONDITIONING, FUNDAMENTAL PRINCIPLES, PRACTICAL INSTALLATIONS AND OZONE FACTS. By E. W. Riesbeck. Second revised and enlarged edition. Chicago, Goodheart-Willcox Company, 1939. 443 pages, illustrated, 8 by 5 inches, flexible, $3.50. In a non-technical manner explains the principles of air conditioning; differentiates between conditioning and cooling; describes methods, equipment, installation, and adaptation, and shows how to figure requirements. Refrigeration, use of ozone, and water sterilization are treated as allied subjects.

ESSENTIALS OF ALTERNATING CURRENTS. By W. H. Timbie and H. H. Higbie. Second edition, rewritten. New York, John Wiley and Sons, 1939. 377 pages, illustrated, 8 by 5 inches, cloth, $2.25. Covers only information which the authors consider essential to the worker on a-c appliances. The revised edition includes new devices and methods of using them and new applications of known devices. Current practice is now represented, as in the treatment of motors and control apparatus. Problems and numerical examples.

INDUSTRIAL ELECTRICITY. By J. M. Nadon and B. J. Gelmine. New York, D. Van Nostrand Company, 1939, 607 pages, diagrams, etc., 9 by 6 inches, cloth, $3.00. Designed for those who intend to make a vocation of electrical work in industry. Contains the fundamental principles of electricity and magnetism, and considers their application to present-day equipment. More specialized topics include connecting methods and operating characteristics of electrical machines and controls, electronic devices, and electric welding.

INTRODUCTION TO CONTEMPORARY PHYSICS. By K. K. Darrow. Second edition. New York, D. Van Nostrand Company, 1939. 648 pages, illustrated, 9 by 6 inches, cloth, $7.00. Explains the principal recent advances in atomic and nuclear physics as fully as is consistent with mathematics not more difficult than the elements of wave-mechanics. Topics include the properties of elementary particles, the correlation of corpuscles and waves, the diffraction of electrons and X rays by crystals, the phenomena of ionization and excitation, the interpretation of spectra, wave mechanics, and the art and science of transmutation. The new edition is much expanded.

METER ENGINEERING. By J. L. Ferns. Third edition. New York and Chicago, Pitman Publishing Corporation, 1938. 347 pages, illustrated, 8 by 5 inches, cloth, $3.75. Revised in accordance with recent developments, this book covers in detail the work connected with the installation, testing, and maintenance of electricity meters.

INDUSTRIAL ELECTRICITY, DIRECT-CURRENT PRACTICE. By W. H. Timbie. Second edition. New York, John Wiley and Sons, 1939. 635 pages, illustrated, 9 by 6 inches, cloth, $3.00. Written to meet the demand from technical schools for a textbook covering the important principles of electrical science as applied to modern industry. Explains how d-c electricity is generated, transmitted, and used, and affords a foundation for the study of the application of a-c electricity to present-day practice. Each chapter is followed by summary and problems.

NATIONAL PHYSICAL LABORATORY REPORT FOR THE YEAR 1938. London, His Majesty's Stationery Office, 1939. 147 pages, tables, 10 by 6 inches, paper (obtainable from British Library of Information, 50 Rockefeller Plaza, New York, $0.75). In addition to general information concerning the laboratory and its work, this publication presents the reports of the William Froude Naval Laboratory and the departments of physics, electricity, radio, metrology, engineering, metallurgy, and aerodynamics, indicating the state of the current researches.

PRINCIPLES AND PRACTICE OF RADIO SERVICING. By H. J. Hicks. New York and London, McGraw-Hill Book Company, 1939. 305 pages, diagrams, etc., 9 by 6 inches, cloth, $3.00. Written with a minimum of mathematics. Shows how to install, test, and repair radio receivers, giving step-by-step instructions in all the servicing procedures, and also a plain treatment of the necessary fundamental theory of electricity and radio.

TRANSACTIONS SECOND CONGRESS ON LARGE DAMS, 1936. Five volumes, edited by O. C. Merrill, International Commission on Large Dams of the World Power Conference. Washington, D. C., Superintendent of Documents, 1938. Volume I, 587 pages; Volume II, 406 pages; Volume III, 492 pages; Volume IV, 651 pages; Volume V, 492 pages, illustrated, 10 by 6 inches, cloth, $2.50 per volume; $10.00 per set of five volumes; 25 per cent discount for 100 volumes or more in a single order. These volumes contain a full report of the Washington, 1936, conference, including the papers presented, the round-table discussions, reports, and information concerning officers, organization, excursions, and other general matters. The questions considered by the conference were: special cements; the design and waterproofing of shrinkage, contraction, and expansion joints; the facing of masonry and concrete dams; geotechnical studies of foundation materials; and the calculation of the stability of earth dams. Other problems considered include: methods for insuring the safety of gravity dams; dams built of precast concrete blocks; dams built by depositing stone blocks in running water; prevention of "piping;" and silting of large reservoirs. Papers are in English, French, Spanish, or German, with summaries in all four languages.

DER ULTRASCHALL UND SEINE ANWENDUNG IN WISSENSCHAFT UND TECHNIK. By L. Bergmann. Second edition. Berlin, VDI-Verlag, 1939. 358 pages, illustrated, 8 by 6 inches, leather, 25 rm. Greatly enlarged second edition of a book intended as a broad survey of our knowledge of ultrasonics, with emphasis upon practical scientific and technical applications. Discusses the production and measurement of ultrasonic waves, and their uses in measuring the velocity and absorption of sound in various media and the elastic constants of solids, also their use in testing materials, in signaling, television, and metallurgy, and their chemical and physical effects. The bibliography has been extended.

WHO INVENTED THE TELEPHONE? By W. Aitkin. London and Glasgow, Blackie and Son, Ltd., 1939. 196 pages, diagrams, 8 by 5 inches, cloth, 5 s. This review of the history of the telephone consists largely of references to or extracts from technical literature. Much of the information on the early inventors and their claims has been gathered from contemporary documents.

Engineering Societies Library

39 West 39th Street, New York, N. Y.

MAINTAINED as a public reference library of engineering and the allied sciences, this library is a co-operative activity of the national societies of civil, electrical, mechanical, and mining engineers.

Resources of the library are available also to those unable to visit it in person. Lists of references, copies or translation of articles, and similar assistance may be obtained upon written application, subject only to charges sufficient to cover the cost of the work required.

A collection of modern technical books is available to any member residing in North America at a rental rate of five cents per day per volume, plus transportation charges.

Many other services are obtainable and an inquiry to the director of the library will bring information concerning them.